Form 801B

DEPARTMENT OF COMMERCE
STEAMBOAT-INSPECTION SERVICE

GREAT LAKES

GENERAL RULES AND REGULATIONS

PRESCRIBED BY THE

BOARD OF SUPERVISING INSPECTORS

AS AMENDED AT BOARD MEETING
OF JANUARY, 1920

▽

EDITION: MAY 20, 1920

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CONTENTS.

AMENDED STEAMBOAT-INSPECTION RULES AND REGULATIONS, GREAT LAKES.

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, May 20, 1920.

United States supervising and local inspectors, Steamboat-Inspection Service, and others concerned:

The General Rules and Regulations prescribed by the Board of Supervising Inspectors are divided into four books, namely, (1) Ocean and coastwise, (2) Great Lakes, (3) Bays, sounds, and lakes other than the Great Lakes, and (4) Rivers.

This book contains the rules and regulations for the Great Lakes.

This edition contains all amendments of the rules and regulations for the Great Lakes made by the Board of Supervising Inspectors at the meetings of January, 1919, and January, 1920, and by the executive committee of the board during the years 1918 and 1919, previously published in supplements to the General Rules and Regulations, which supplements were numbered 14 to 23, inclusive. This edition also contains a list of all approved vessel equipments.

The amendments of the rules and regulations above referred to have been approved by the Secretary of Commerce, and have the force of law, under the provisions of section 4405, Revised Statutes, and must be observed accordingly.

J. W. ALEXANDER,
Secretary of Commerce.

OFFICERS OF THE STEAMBOAT-INSPECTION SERVICE.[1]

GEO. UHLER, *Supervising Inspector General.*
DICKERSON N. HOOVER, Jr., *Deputy Supervising Inspector General,*
Washington, D. C.

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Second district.—Henry M. Seeley, New York, N. Y.
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Fourth district.—------ ------, St. Louis, Mo.
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Samuel A. Mills, Philadelphia, Pa.
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TERRITORY EMBRACED IN SUPERVISING DISTRICTS.

FIRST DISTRICT embraces all the waters of the United States west of the Rocky Mountains and south of a line drawn east from Cape Disappointment to the intersection of the forty-seventh parallel of north latitude and longitude 112° 30′ west, and the Hawaiian Islands.

SECOND DISTRICT embraces all the waters of Long Island Sound west of the Connecticut River and the tributaries thereto, that portion of Long Island lying west of Riverhead, and the waters of the

[1] List of officers corrected to May 20, 1920.

Atlantic coast, rivers, and tributaries from Long Island to Cape Charles.

THIRD DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries between Cape Charles and Cape Sable.

FOURTH DISTRICT embraces the Mississippi River and tributaries from above Greenfield, Mo., to the head of navigation on the Missouri River, and to the head of navigation on the Illinois River.

FIFTH DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries from the eastern boundary of the United States to and including the Connecticut River, and that portion of Long Island east of and including Riverhead.

SIXTH DISTRICT embraces the Ohio River and tributaries up to and including Carrollton, Ky., and the Mississippi River and tributaries from Greenville, Miss., up to and including Greenfield, Mo.

SEVENTH DISTRICT embraces the Ohio River and tributaries above Carrollton, Ky.

EIGHTH DISTRICT embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

NINTH DISTRICT embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, and Champlain, and their tributaries.

TENTH DISTRICT embraces the coast and tributary waters of the Gulf of Mexico, between Cape Sable and the mouth of the Rio Grande, and the Mississippi River and tributaries to Greenville, Miss., and Porto Rico.

ELEVENTH DISTRICT embraces all the waters in the States of Washington, Idaho, and Montana north of a line drawn east from Cape Disappointment to the intersection of the forty-seventh parallel of north latitude and longitude 112° 30′ west, and also all United States waters in the Territory of Alaska.

SUPERVISING AND LOCAL INSPECTION DISTRICTS.

Supervising inspection districts.	Local inspection districts (ports).	Supervising inspection districts.	Local inspection districts (ports).
First	San Francisco, Calif.	Seventh	Pittsburgh, Pa.
	Honolulu, Hawaii.		Cincinnati, Ohio.
	Los Angeles, Calif.		Point Pleasant, W. Va.
	Portland, Oreg.	Eighth	Detroit, Mich.
Second	New York, N. Y.		Chicago, Ill.
	Albany, N. Y.		Duluth, Minn.
	New Haven, Conn.		Grand Haven, Mich.
	Philadelphia, Pa.		Marquette, Mich.
Third	Norfolk, Va.		Milwaukee, Wis.
	Baltimore, Md.		Port Huron, Mich.
	Charleston, S. C.	Ninth	Cleveland, Ohio.
	Jacksonville, Fla.		Buffalo, N. Y.
	Savannah, Ga.		Burlington, Vt.
Fourth	St. Louis, Mo.		Oswego, N. Y.
	Dubuque, Iowa.		Toledo, Ohio.
Fifth	Boston, Mass.	Tenth	New Orleans, La.
	Bangor, Me.		Apalachicola, Fla.
	New London, Conn.		Galveston, Tex.
	Portland, Me.		Mobile, Ala.
	Providence, R. I.		San Juan, P. R.
Sixth	Louisville, Ky.		Tampa, Fla.
	Evansville, Ind.	Eleventh	Seattle, Wash.
	Memphis, Tenn.		Juneau, Alaska.
	Nashville, Tenn.		St. Michael, Alaska.

GENERAL RULES AND REGULATIONS.

GREAT LAKES.

Rule I.—Boiler Plate.

STAMPS.

1. Every iron or steel plate intended for the construction or repairs of boilers to be used on steam vessels shall be stamped by the manufacturer in the following manner, at two diagonal corners, at a distance of about 18 inches from the edges.

Plates to be used in externally fired boilers the thickness of which shall not exceed one-half inch for steamers navigated under the provisions of Title LII, Revised Statutes, which will be subject to tensile strain in said boilers, shall be tested and inspected by an inspector duly authorized under the provisions of said title, and such plates shall not be stamped until they have been tested by the inspector, and each of such plates shall then be stamped by the manufacturer in the presence of the inspector with the name of the manufacturer, the place where manufactured, and the minimum number of thousand pounds tensile stress it will bear to the sectional square inch as has been determined by the test.

Plates to be used in the construction or repair of boilers other than the externally fired boilers as described in above paragraph, for steamers navigated under provisions of Title LII, Revised Statutes, which shall be subject to tensile strain in said boilers shall be tested and inspected by an inspector duly authorized under provisions of said title and such plates shall be stamped by the manufacturer before same are tested with the name of the manufacturer, the place where manufactured, and the minimum number of pounds the plate will bear to the sectional square inch, expressed in thousands.

Inspectors testing iron or steel plate at the mills where same is manufactured shall allow the mills to shear any plate into butt straps or heads before the coupon from the plate is tested, and they shall accept the statement of the manufacturer that the coupon presented to the inspector for testing was taken from the plate from which the butt straps or heads were cut, and if the coupon meets all the requirements of Rule I, the inspector shall stamp, in one place where it is most likely to be left legible after working into the boiler, all heads and butt straps cut from the plate.

All plates which conform to the physical, chemical, and other requirements prescribed by these rules shall be stamped by the inspector near the manufacturer's stamp, with the official stamp of the United States Steamboat-Inspection Service, and with the initials of his name and a serial number. (Sec. 4430, R. S.)

2. Plates may be tested and inspected at the mills for repairs to marine boilers or to be carried in stock, the report of such test to be in duplicate, one copy to be furnished through the supervising inspector to the local inspectors in the district where the purchaser of such material is located, and the other to the purchaser, who shall deliver a copy of the same to the parties using the material, who, in turn, shall submit the same to the local inspectors in the district where the material is to be used, before being assembled in the boiler. Steamers carrying such repair material to be used in emergencies shall carry the record of each sheet of such material on board. (Secs. 4430, 4431, R. S.)

3. Boilers built since February 28, 1872, of material stamped and tested according to the requirements of section 4430, Revised Statutes, and having a record thereof in the office of the local inspectors in the district where the boiler was built or intended to be used, may be used for marine purposes, notwithstanding that such boilers may have been used for other purposes, if in the judgment of the local inspectors they are deemed safe. (Sec. 4430, R. S.)

CHEMICAL PROPERTIES, STEEL PLATES.

4. Steel plates shall be made by the open-hearth process, except that steel for plates to be used in the manufacture of boiler tubes may be made by the Bessemer process.

Open-hearth steel shall contain not more than 0.04 per cent of phosphorus nor more than 0.05 per cent of sulphur.

The manufacturer shall furnish the inspector, with each order tested, a certificate stating the process by which the steel was manufactured and a copy of the analysis of each melt. The analysis may, if deemed expedient by the Supervising Inspector General, be verified at the expense of the manufacturer. (Secs. 4405, 4430. R. S.)

PHYSICAL PROPERTIES. STEEL PLATES.

5. All steel plates tested shall show an elongation of at least 20 per cent measured in a gauge length of 8 inches. (Sec. 4430, R. S.)

PHYSICAL PROPERTIES, IRON PLATES.

6. The tensile strength shall be not less than 45,000 pounds per square inch. The elongation shall be not less than 15 per cent. The reduction of area shall be not less than 15 per cent for 45,000 pounds tensile strength, and for each increase of 1,000 pounds tensile strength up to 55,000 pounds, an addition of 1 shall be made to the required percentage of reduction of area. The bend test specimen shall bend cold through 90° around a curve the radius of which is not greater than one and one-half times the thickness of the specimen. (Sec. 4430, R. S.)

7. All tension test specimens shall be milled to the form as shown in figure 1, with the following dimensions: Length at least 16 inches, ends from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches wide by about 3 inches in length, and parallel section at center 1 to $1\frac{1}{2}$ inches wide by 9 inches in length. The percentage of elongation shall be measured in a gauge length of 8 inches.

Where specimens are to be tested on the testing machines of the Steamboat-Inspection Service, they shall be 1 inch wide at parallel section in center, and shall not exceed 2 inches in width on the ends.

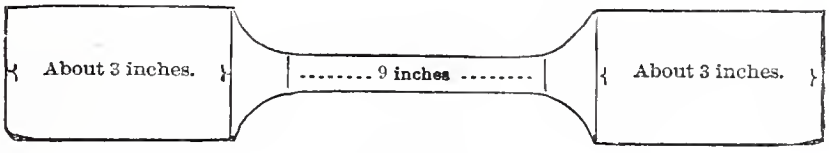


FIGURE 1.

All bend test specimens shall be at least 12 inches in length and from 1 to $3\frac{1}{2}$ inches in width, and the full thickness as rolled. The edges may be planed. The corners shall not be rounded, but the sharpness may be removed with a fine file. After bending, the specimens shall show no cracks or flaws on the outside of the bent portion.

Bend test specimens for steel plates, before bending, shall be heated to a cherry red as seen in the dark, and quenched in water the temperature of which is about 82° F.

Two tension tests and one quench bend test shall be made from each plate as first rolled from the billet, slab, or ingot, the tensile test specimens to be taken from the diagonal corners of the plate, and the quench bend specimen to be taken from that part of the plate which represents the top of the billet, slab, or ingot.

The quench bend specimen shall withstand, without fracture, being bent over until the ends are parallel and the inner radius equal to one and one-half times the thickness of the test specimen.

The finished material shall be free from all injurious defects, and shall have a good and workmanlike finish.

All measurements of test specimens and material shall be made by any standard American gauge, and record of tests shall be submitted on Form 934. (Secs. 4405, 4430, R. S.)

8. [Form 935.]

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS CONSTRUCTED OF MATERIAL TESTED AT THE MILLS.

DEPARTMENT OF COMMERCE,
STEAMBOAT-INSPECTION SERVICE.

STATE OF ———, *County of* ———.

On this —— day of ———, A. D. 191—, personally appeared before me, ——— ———, a notary public in and for the county of ——— and State of ———, Mr. ——— ———, who deposes and says that he is ——— ———, of ——— ———, boiler manufacturer, and has contracted to build — marine boiler– for ——— ———, of ——— ———, from ——— plate manufactured by ——— ———, of ——— ———, which plate was tested at the mills by a United States assistant inspector, as provided in the act of Congress approved January 22, 1894, each of said plates having stamped thereon the words "U. S. Assistant Inspector" and the initials — —, and numbered as follows: ———.

No plate for shell or other part of boiler subject to tensile strain, other than herein specified, will be used in the construction of said boiler–, the lowest tensile strength stamped thereon being ——— pounds.

The dimensions of the boiler– will be: Length, ———; diameter, ———.

	Material.	Number.	Length.	Thickness.	Diameter.
Tubes					
Flues					
Furnaces					

Kind of furnaces, ——; round, ——; corrugated, ——; flat sides, ——. Thickness of plates of cylindrical shell of boiler, ——; thickness of side sheets in flat side of furnace, ——; thickness of flat top sheet of back connection, ——; thickness of plates of cylindrical shell of back connection, ——; thickness of material of boiler heads, ——; thickness of tube sheets, ——; thickness of plates of shell of steam chimney, ——; thickness of plates in lining of steam chimney, ——; thickness of side sheets, ——. Kind of rivets (iron or steel), ——; diameter of rivet holes, ——; pitch of rivets, ——. All rivet holes of boiler–, including steam and mud drums, will be fairly drilled and no part of such holes will be punched, ———; or punched, ———. All tubes used in the construction of said boiler– are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler —— to be inspected, —— pounds. Style of boiler, ——. Boiler– to be installed upon the steamer ———.

Signature: ——— ———.

Subscribed and ——— to before me this —— day of ———, 191–.
(Sworn or affirmed.)

[NOTARY'S SEAL.]

———— ————,
Notary Public.

NOTE.—Inspectors will not accept this affidavit without the data required, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

(Sec. 4405, R. S.)

9. [Form 936.]

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS.

DEPARTMENT OF COMMERCE,
Steamboat-Inspection Service.

STATE OF ———, *County of* ———.

On this —— day of ———, A. D. 191—, personally appeared before me, ——— ———, a notary public in and for the county of ——— and State of ———,

Mr. ——— ———, who deposes and says that he is ——— ———, of ——— ———, boiler manufacturer, and that the accompanying samples of ———, manufactured by ——— ———, of ——— ———, were cut from plates which are to be used in the construction of —— marine boiler– for ———, of ———, and no plate for shell or other part of boiler subject to tensile strain of less tensile strength or quality than that determined by the United States inspector who made the tests, which lowest tensile strength found was ——— pounds, will be used in the construction of said boiler–, the dimensions of which will be: Length, ———; diameter, ———.

	Material.	Number.	Length.	Thickness.	Diameter.
Tubes					
Flues					
Furnaces					

Kind of furnaces, ——; round, ——; corrugated, ——; flat sides, ——. Thickness of plates of cylindrical shell of boiler, ——; thickness of side sheets in flat side of furnace, ——; thickness of flat top sheet of back connection, ——; thickness of plates of cylindrical shell of back connection, ——; thickness of material of boiler heads, ——; thickness of tube sheets, ——; thickness of plates of shell of steam chimney, ——; thickness of plates in lining of steam chimney, ——; thickness of side sheets, ——. Kind of rivets (iron or steel), ——; diameter of rivet holes, ——; pitch of rivets, ——. All rivet holes of boiler–, including steam and mud drums, will be fairly drilled and no part of such holes will be punched, ———; or punched, ———. All tubes used in the construction of said boiler– are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler —— to be inspected, —— pounds. Style of boiler, ——. Boiler to be installed upon the steamer ———.

Signature: ——— ———.

Subscribed and ——— to before me this —— day of ———, 191—.
(Sworn or affirmed.)

[NOTARY'S SEAL.]

——— ———,
Notary Public.

NOTE.—Inspectors will not accept this affidavit unless the data required are given, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

Inspectors may make requisition on the department for the necessary supply of blank affidavits for the use of boiler manufacturers. (Sec. 4405, R. S.)

FOREIGN-BUILT BOILERS.

10. Boilers of foreign-built vessels admitted to American registry shall be inspected in the same manner as boilers on American vessels.

The working steam pressure shall be determined by the application of the hydrostatic pressure in the ratio as required by the laws of the United States and by a close observation of the general condition of the boiler.

The working steam pressure under which the boilers are being operated shall be accepted as the basis for determining the allowable working pressure where it is not practicable or possible to secure a record of the tests of the plates entering into the construction of the boiler. (Sec. 4405, R. S.)

Rule II.—Boilers and Attachments.

DRAWINGS OF BOILERS.

1. The manufacturer of any boiler to be used for marine purposes shall furnish the inspectors of the district where such boiler or boilers are to be inspected duplicate blue prints or tracings fully descriptive of same in detail for their approval, one of which shall be kept on file in the office of the local inspectors and the other returned to the manufacturer. Where more than one boiler is made from a similar design, a drawing of which is on file in the local inspectors' office, if made at a different date, a reference to such drawing on file is all that shall be required. The manufacturer shall also furnish the inspectors an affidavit on either Form 935 or 936, as contained in sections 8 and 9 of Rule I.

It shall be the duty of every local inspector of boilers to make, for every new boiler inspected in his district, all computations required by the rules and regulations, and any other necessary computations, from data obtained from blue prints or tracings, boiler manufacturers' affidavits, tensile test reports, and from other reliable sources. A record of such computations in full shall be made on letter sheets and filed with blue prints or tracings of boiler, the first sheet of such computations to be headed with a general description of boiler and with the vessel file number. (Secs. 4405, 4418, R. S.)

CYLINDRICAL SHELLS.

2. The working steam pressure allowable on cylindrical shells of boilers constructed of plates inspected as required by these rules, when single riveted, shall not produce a strain to exceed one-sixth of the tensile strength of the iron or steel plates of which such boilers are constructed; but where the longitudinal laps of the cylindrical parts of such boilers are double riveted, and the rivet holes for such boilers have been fairly drilled instead of punched, an addition of 20 per cent to the working pressure provided for single riveting shall be allowed.

The pressure for any dimension of boilers shall be ascertained by the following rule, viz:

Multiply one-sixth of the lowest tensile strength found stamped on the plates in the cylindrical shell by the thickness—expressed in inches or part of an inch—and divide by the radius or half diameter, also expressed in inches, and the result will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent where the longitudinal laps of the cylindrical parts of such boiler are double riveted, when all the rivet holes of such boiler, including steam and mud drums, have been fairly drilled and no part of such holes has been punched. The pressure allowed shall be based on the plate whose tensile strength multiplied by its thickness gives the lowest product.

GUIDE HOLES FOR DRILLS AND CUTTERS MAY BE PUNCHED.

Centers or guide holes not to exceed 75 per cent of the diameter of the full-size finished hole for tubes and stays may be punched. The remainder shall be cleanly cut, drilled, or reamed to full size. Holes not to exceed 4 inches in diameter in plates five-eighths of an inch thick and under may be punched to within one-half inch of the full diameter of the finished hole; the remainder shall be cleanly cut, drilled, or reamed to full size. (Sec. 4433, R. S.)

HEADS.

REQUIREMENTS FOR HEADS.

3. All plates used as heads, when new and made to practically true circles, and as described below, shall be allowed a steam pressure in accordance with the following formula:

CONVEX HEADS.

$$P=\frac{T\times S}{R}$$

Where P=steam pressure allowable in pounds.
T=thickness of plate in inches.
S=one-fifth of the tensile strength.
R=one-half of the radius to which the head is bumped.

CONCAVE HEADS.

For concave heads the pressure allowable shall be eight-tenths times the pressure allowable for convex heads.

NOTE.—To find the radius of a sphere of which the bumped head forms a part, square the radius of head, divide this by the height of bump required; to the result add height of bump, which will equal diameter of sphere, one-half of which will be the required radius.

Example.

Required, the working pressure of a convex head of a 54-inch radius; material, 60,000 pounds tensile strength and one-half of an inch thick. Substituting values and solving, we have

$$P=\frac{0.5\times 12{,}000}{27}=222 \text{ pounds.}$$

The pressure allowable on a concave head of the same dimensions would be $222\times.8=177$ pounds.

To avoid grooving, the flanging shall be well rounded at the bend.

Bumped heads may contain a manhole opening flanged inwardly, when such flange is turned to a depth of three times the thickness of material in the head.

Material used in the construction of all bumped heads shall possess the physical and chemical qualities prescribed by the Board of Supervising Inspectors for all plates subject to tensile strain, as required by section 4430, Revised Statutes.

FLAT HEADS OF WROUGHT-IRON OR STEEL PLATE.

Where flat heads do not exceed 20 inches in diameter they may be used without being stayed, and the steam pressure allowable shall be determined by the following formula:

$$P=\frac{C\times T^2}{A}$$

Where P=steam pressure allowable in pounds.
T=thickness of material in sixteenths of an inch.
A=one-half the area of head in inches.
C=112 for plates seven-sixteenths of an inch and under.
C=120 for plates over seven-sixteenths of an inch.

Provided, The flanges are made to an inside radius of at least $1\frac{1}{2}$ inches.

Example.

Required the working pressure of a flat head 20 inches in diameter and three-fourths of an inch thick. Substituting values, we have

$$P=\frac{120\times 144}{157}=110 \text{ pounds.}$$

(Sec. 4418, R. S.)

MANHOLES, HANDHOLES, AND HOLES FOR PIPE CONNECTIONS.

4. All boilers built on and after August 1, 1914, shall have a manhole opening above the flues or tubes of not less than 10 by 16 inches, 11 by 15 inches, or of an equal area, in the clear, and shall have such other manhole openings in other parts of the boiler as may be required by local inspectors when considering blue prints or tracings submitted to them for approval, of sufficient dimensions to allow easy access to the interior of the boiler for the purpose of inspection and examination.

When holes exceeding 6 inches in diameter are cut in boilers for pipe connections, manhole and handhole plates, such holes shall be reinforced, either on the inside or outside of boiler, with reinforcing wrought-iron or steel rings, which shall be securely riveted or properly fastened to the boiler, such reinforcing material to be rings of sufficient width and thickness of material to fully compensate for the amount of material cut from such boilers, in flat surfaces; and where such opening is made in the circumferential plates of such boilers, the reinforcing ring shall have a sectional area equal to at least one-half of the sectional area of the opening parallel with the longitudinal seams of such portion of the boiler. On boilers carrying 75 pounds or less steam pressure a cast-iron stop valve, properly flanged, may be used as a reinforcement to such opening. When holes are cut in any flat surface of such boilers and such holes are flanged inwardly to a depth of not less than $1\frac{1}{2}$ inches, measuring from the outer surface, the reinforcement rings may be dispensed with.

When reinforcing rings as described above are made of wrought iron or steel, the material shall not be required to be tested.

Seamless forged steel nozzles may be used for reinforcing holes cut in boilers when the amount of material in the flange of the saddle that is secured to the boiler is equal to the amount of material removed from the boiler.

No connection between shell of boiler and mud drum shall exceed 9 inches in diameter, and the flange of the mud-drum leg shall consist of an equal amount of material to that cut out of the shell of boiler. (Sec. 4418, R. S.)

DONKEY BOILERS.

5. Donkey boilers shall be inspected in the same manner as the main boilers. (Sec. 4418, R. S.)

DRILLING TO DETERMINE THICKNESS.

6. The shell of any boiler which has reached the age of 10 years shall, at the first annual inspection thereafter, and at such subsequent periods as the local or supervising inspectors may deem necessary, be drilled near the water line and at such other points in the shell as may be necessary to determine as nearly as possible the thickness of material, which ascertained thickness, together with the general condition of the boiler, shall govern the steam pressure allowed. (Secs. 4418, 4430, R. S.)

HYDROSTATIC PRESSURE.

7. The hydrostatic pressure applied shall be in the proportion of 150 pounds to the square inch to 100 pounds to the square inch of the steam pressure allowed, and the inspector, after applying the hydrostatic test, shall thoroughly examine every part of the boiler. The hydrostatic pressure shall also be applied to the main steam pipe up to the throttle.

In the application of the hydrostatic pressure to boilers, inspectors shall require such arrangements as will guard against main and auxiliary stop valves being subjected to hydrostatic pressure on one side at the same time that steam pressure is exerted on the opposite side. (Sec. 4418, R. S.)

STEAM CHIMNEYS.

8. When steam chimneys constructed of flues subject to external pressure have a thickness of not less than seven-sixteenths of an inch, and the flue is heated only with the waste gases, and the temperature does not exceed 600° F., the working pressure shall be determined by the rules for plain furnaces or flues, corrugated furnaces, and Adamson type. When flues are strengthened with tee irons, angle irons, or bowling rings the working pressure shall be determined by formula for plain furnace flues. When angle or tee bars are used they shall have a thickness of leaf of at least two-thirds that of plate and a depth of at least one-fourth of pitch. Said tee bars shall be substantially riveted to flue. All rivet holes in tees shall be drilled, holes shall be staggered, distance from center of rivet holes to edge of tees shall be not less than 1.5 times diameter of rivet holes, and percentage of plate section shall be not less than rivet section. Bowling rings may be used, as they increase the strength and provide for expansion of flue. For all boilers carrying a steam pressure of over 60 pounds and not over 100 pounds per square inch the flue may be braced with socket bolts in lieu of tee rings. Such bolts shall have heads and the ends shall be threaded for nuts, with plate washers or equivalent on the inside of flue. Pitch of stays and bolts and the maximum stress in pounds allowable per square inch of cross-sectional area for stays and bolts shall be determined by section 16, Rule II.

If a greater working stress is desired on flues than that permitted by the formula for flues strengthened with bowling rings or tee irons. the flue may be braced to shell and may be deemed a flat surface, and shall be stayed in strict accordance with the rules for stays.

Drainpipes shall be fitted to steam chimneys in which water is liable to collect. Steam chimneys that are arranged to be disconnected from main boiler shall be provided with a safety valve not less than 3 inches in diameter and with a steam gauge, and shall be provided with manholes to enable inspectors to examine every portion of the interior. (Sec. 4418, R. S.)

RIVETED JOINTS.

9. The diameter of rivets, rivet holes, distance between centers of rivets, and distance from centers of rivets to edge of lap for different thicknesses of plates for single and double riveting shall be determined by the following rules.

The following formulas, equivalent to those of the British Board of Trade, are given for the determination of the pitch, distance between rows of rivets, diagonal pitch, maximum pitch, and distance from centers of rivets to edge of lap of single and double riveted lap joints for both iron and steel boilers:

Let p=greatest pitch of rivets in inches.
n=number of rivets in one pitch.
p_d=diagonal pitch in inches.
d=diameter of rivets in inches.
T=thickness of plate in inches.
V=distance between rows of rivets in inches.
E=distance from edge of plate to center of rivet in inches.

TO DETERMINE THE PITCH.

Iron plates and iron rivets:

$$p=\frac{d^2\times 0.7854\times n}{T}+d.$$

Example, first, for single-riveted joint: Given, thickness of plate (T)=$\frac{1}{2}$ inch, diameter of rivet (d)=$\frac{7}{8}$ inch. In this case n=1. Required the pitch.

Substituting in formula, and performing operation indicated,

$$\text{Pitch}=\frac{(\frac{7}{8})^2\times 0.7854\times 1}{\frac{1}{2}}+\frac{7}{8}=2.077 \text{ inches.}$$

Example for double-riveted joint: Given, t=$\frac{1}{2}$ inch and d=$\frac{13}{16}$ inch. In this case n=2. Then—

$$\text{Pitch}=\frac{(\frac{13}{16})^2\times 0.7854\times 2}{\frac{1}{2}}+\frac{13}{16}=2.886 \text{ inches.}$$

For *steel* plates and steel rivets:

$$p=\frac{23\times d^2\times 0.7854\times n}{28\times T}+d.$$

Example for single-riveted joint: Given, thickness of plate=$\frac{1}{2}$ inch, diameter of rivet=$\frac{15}{16}$ inch. In this case n=1.

$$\text{Pitch}=\frac{23\times(\frac{15}{16})^2\times 0.7854\times 1}{28\times\frac{1}{2}}+\frac{15}{16}=2.071 \text{ inches.}$$

Example for double-riveted joint: Given, thickness of plate=$\frac{1}{2}$ inch, diameter of rivet=$\frac{7}{8}$ inch. n=2. Then—

$$\text{Pitch}=\frac{23\times(\frac{7}{8})^2\times 0.7854\times 2}{28\times\frac{1}{2}}+\frac{7}{8}=2.85 \text{ inches.}$$

FOR DISTANCE FROM CENTER OF RIVET TO EDGE OF LAP.

$$E=\frac{3\times d}{2}.$$

Example: Given, diameter of rivet (d)=$\frac{7}{8}$ inch; required the distance from center of rivet to edge of plate.

$$E=\frac{3\times\frac{7}{8}}{2}=1.312 \text{ inches, for single or double riveted lap joint.}$$

FOR DISTANCE BETWEEN ROWS OF RIVETS.

The distance between lines of centers of rows of rivets for double, chain-riveted joints (V) shall not be less than twice the diameter of rivet, but it is more desirable that V should not be less than

$$\frac{4d+1}{2}.$$

Example under latter formula: Given, diameter of rivet=$\frac{7}{8}$ inch, Then—

$$V=\frac{(4\times\frac{7}{8})+1}{2}=2.25 \text{ inches.}$$

For ordinary, double, zigzag riveted joints:

$$V=\frac{\sqrt{(11p+4d)\quad(p+4d)}}{10}.$$

Example: Given, pitch=2.85 inches, and diameter of rivet=$\frac{7}{8}$ inch, Then—

$$V=\frac{\sqrt{(11\times 2.85+4\times\frac{7}{8})\quad(2.85+4\times\frac{7}{8})}}{10}=1.487 \text{ inches.}$$

DIAGONAL PITCH.

For double, zigzag riveted lap joint. Iron and steel:

$$p_d=\frac{6p+4d}{10}$$

Example: Given, pitch=2.85 inches, and d=$\frac{5}{8}$ inch. Then—

$$p_d=\frac{(6\times 2.85)+(4\times\frac{5}{8})}{10}=2.06 \text{ inches.}$$

MAXIMUM PITCHES FOR RIVETED LAP JOINTS.

For single-riveted lap joints:

$$\text{Maximum pitch}=(1.31\times T)+1\tfrac{5}{8}.$$

For double-riveted lap joints:

$$\text{Maximum pitch}=(2.62\times T)+1\tfrac{5}{8}.$$

Example: Given, a thickness of plate=$\frac{1}{2}$ inch, required the maximum pitch allowable.

For single-riveted lap joint:

$$\text{Maximum pitch}=(1.31\times\tfrac{1}{2})+1\tfrac{5}{8}=2.28 \text{ inches.}$$

For double-riveted lap joint:

$$\text{Maximum pitch}=(2.62\times\tfrac{1}{2})+1\tfrac{5}{8}=2.935 \text{ inches.}$$

To determine the pitch of rivets from the above formulas, use the diameter and area of the rivet holes. The diameter of the rivets is the diameter of the driven rivet.

Any riveted joint shall be allowed when it is constructed so as to give an equal percentage of strength to that obtained by the use of the formula given. (Secs. 4418, 4433, R. S.)

BUTT STRAPS.

10. Where butt straps are used in the construction of marine boilers, the straps for single butt strapping shall in no case be less than the thickness of the shell plates; and where double butt straps are used, the thickness of each shall in no case be less than five-eighths the thickness of the shell plates. (Sec. 4418, R. S.)

WOODWORK FROM BOILERS.

11. *Externally heated boilers* shall have a clear space between the boiler and the woodwork of not less than 6 inches at the sides and 4 inches at the top.

Internally heated boilers shall have a clear space between the boiler and the woodwork of not less than 4 inches at the sides and 4 inches at the top.

All woodwork or other ignitible substance approaching within 12 inches of the boiler or smokestack (unless such boiler or smokestack is covered with good nonconducting material) shall be suitably sheathed with metal over noncombustible material, and it shall be the duty of the inspectors to see that all woodwork or other ignitible substance in or around the fireroom is properly protected by metal or asbestos sheathing.

All boilers hereafter placed in wooden steamers shall have a clear space of at least 8 inches between the underside of the cylindrical shell and the floor or keelson; and on all other steamers the boilers shall be so placed as to permit of proper inspection of the underside thereof.

All water-tube or coil boilers shall have a clear space of not less than 4 inches between the back end of boiler and bulkhead. All other boilers shall have a clear space of not less than 2 feet between the back end of boiler and bulkhead. (Secs. 4418, 4470, R. S.)

ANGLE STIFFENERS FOR CURVED SURFACES.

12. Where rounded bottoms of combustion chambers are stiffened with single angle-iron stiffeners, such angles shall have a thickness of leaf eight-tenths that of the plate and a depth of at least one-half pitch. Where stiffened with double angle irons or tee bars, such angles or tee bars shall have a thickness of leaf at least two-thirds that of plate and a depth of at least one-fourth of pitch. Said angles or tee bar shall be substantially riveted to the plate supported. Where the bottoms of combustion chambers are strengthened by angles or tee irons, the same shall be on the water side of the combustion chambers, as shown in the sketches on pages 25–29.

Where rounded tops of combustion chambers are stiffened with single or double angle-iron stiffeners or tee bars, such angles or tee bars shall be of thickness and depth of leaf not less than specified for rounded bottoms of combustion chambers. Said angles or tee bars shall be supported on thimbles and riveted through with rivets not less than 1 inch in diameter and spaced not to exceed 6 inches between centers.

Working pressure allowed on rounded surfaces supported by angle irons or tee bars shall be determined by the following formula:

$$\text{Working pressure}=\frac{900\times T^2}{P\times D}$$

Where T=thickness of plate in sixteenths of an inch.
P=pitch of angle or tee stiffeners, in inches.
D=diameter of curve to which plate is bent, in inches.

Example.

Given $T=\frac{2}{16}$ of an inch. P=7 inches. D=51 inches.
Substituting values in formula and solving,

$$\text{Working pressure}=\frac{900\times 81}{7\times 51}=204 \text{ pounds per square inch.}$$

PRESSURE PERMISSIBLE ON ROUNDED BOTTOM OF COMBUSTION CHAMBERS, ANGLES BEING OMITTED, AND TUBE SHEETS.

$$P=\frac{50\ (300T-2L)}{D}$$

Where P=working pressure in pounds.
T=thickness of bottom plate of combustion chamber, in inches.
L=extreme length of plate forming bottom of combustion chamber, in inches.
D=twice outside radius of bottom of combustion chamber, in inches.

Required working pressure on bottom plate of a combustion chamber, angles being omitted: Thickness of plate, 0.82 of an inch; extreme length of plate, 33 inches; twice the radius of bottom of combustion chamber, 50 inches. Substituting and solving:

$$P=\frac{50\times(300\times0.82-2\times33)}{50}=180 \text{ pounds.}$$

$$T=\frac{P\times D+100L}{15{,}000}$$

Pressure allowable on tube sheets where combustion chambers are not suspended from the shell of the boiler shall be determined by the following formula:

$$P=\frac{(D-d)T\times27{,}000}{W\times D}$$

Where P = working pressure in pounds.
D = least horizontal distance between tube centers in inches.
d = inside diameter of tubes in inches.
T = thickness of tube plate in inches.
W = extreme width of combustion chamber in inches.

Required the working pressure of a tube sheet supporting a crown sheet braced by crown bars. Horizontal distance between centers, $4\frac{1}{8}$ inches; inside diameter of tubes, 2.782 inches; thickness of tube sheets, eleven-sixteenths of an inch; extreme width of combustion chamber, $34\frac{1}{4}$ inches, measured from outside of tube plate to outside of back plate; material, steel. Substituting and solving:

$$P=\frac{(4.125-2.782)\times0.6875\times27{,}000}{34.25\times4.125}=176 \text{ pounds pressure.}$$

The compressive stress on tube plates, as determined by the following formula, shall not exceed 13,500 pounds per square inch, when pressure on top of combustion chamber is supported by vertical plates of such chamber.

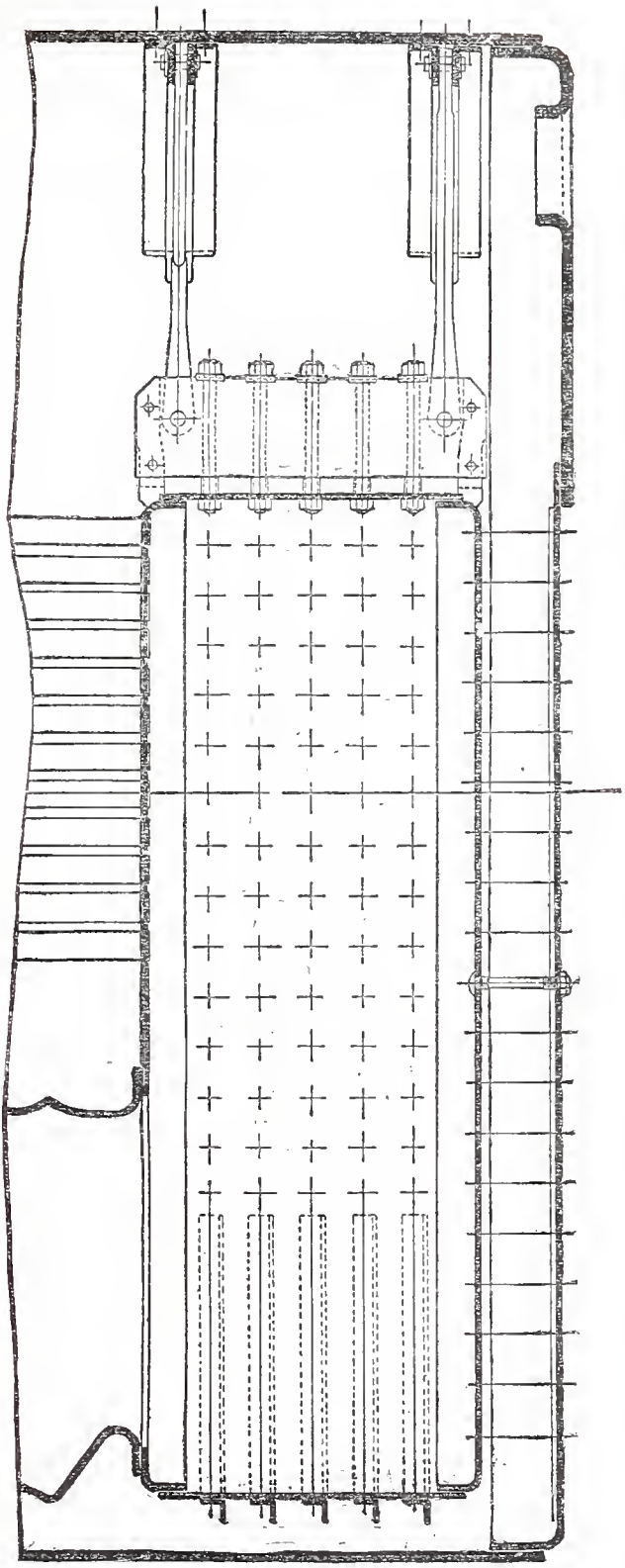
$$C=\frac{P\times D\times W}{2\,(D-d)\,T}$$

Where C = stress on tube sheet.
P = working pressure in pounds.
D = least horizontal distance between tube centers in inches.
d = inside diameter of tube in inches.
W = extreme width of combustion chamber in inches.
T = thickness of tube sheet in inches.

Sling stays may be used in lieu of girders in all cases: *Provided, however*, That when such sling stays are used, girders or screw stays of the same sectional area shall be used for securing the bottom of combustion chamber to the boiler shell.

When girders are dispensed with and the top and bottom of combustion chambers are secured by sling stays or braces, the sectional area of such stays shall conform with the requirements of section 16, Rule II.

The following drawings show an excellent practice of constructing combustion chambers with and without sling stays:

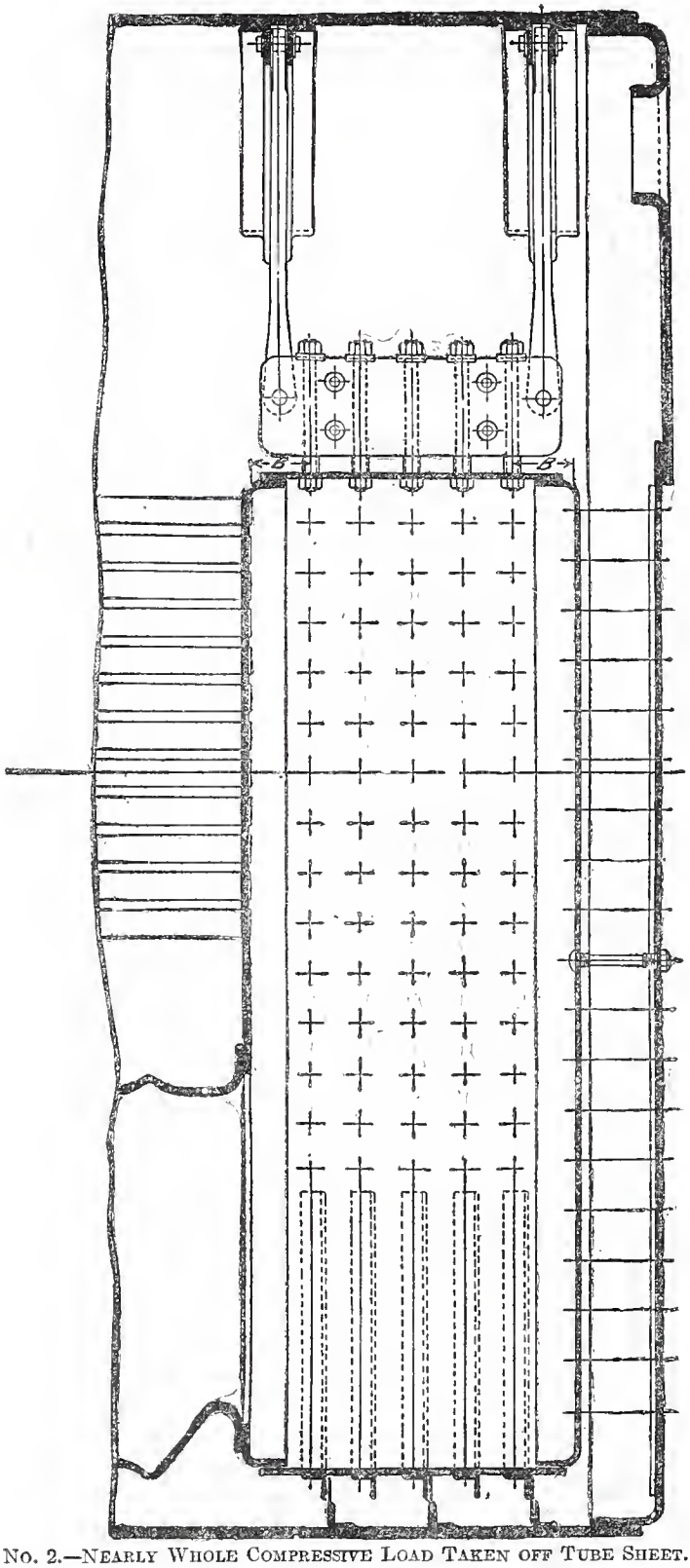


No. 1.—Full Load on Tube Sheet and Back Plate.

Diameter of hangers should be sufficient to carry the weight of combustion chamber and one-half the tubes and furnaces when no water is in boiler. No effect of buoyancy is considered.

These remarks are for separate combustion chambers when they are not secured to the shell at the bottom and therefore liable to bend the small screw stays.

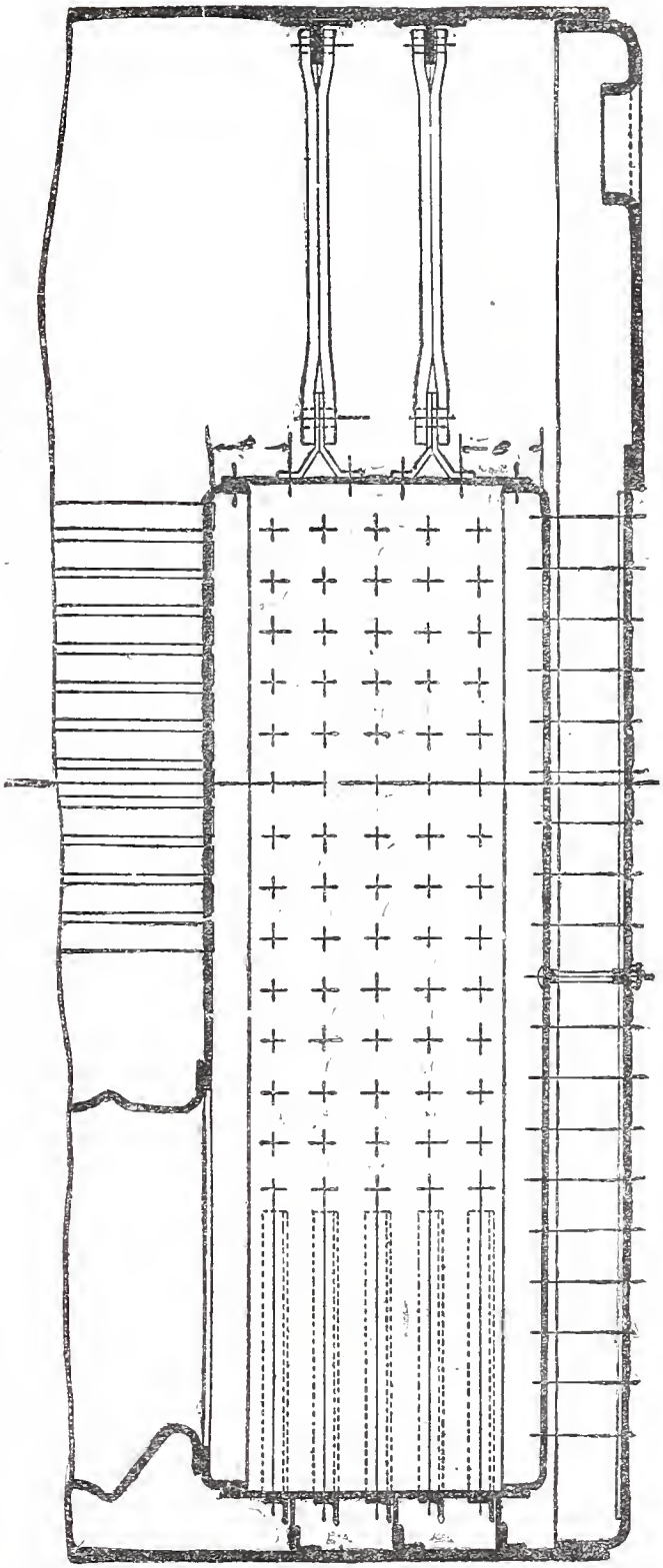
In this case the tube sheet and back plate get the full compressive load in a similar manner to a boiler without hanging stays.



No. 2.—Nearly Whole Compressive Load Taken off Tube Sheet.

Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

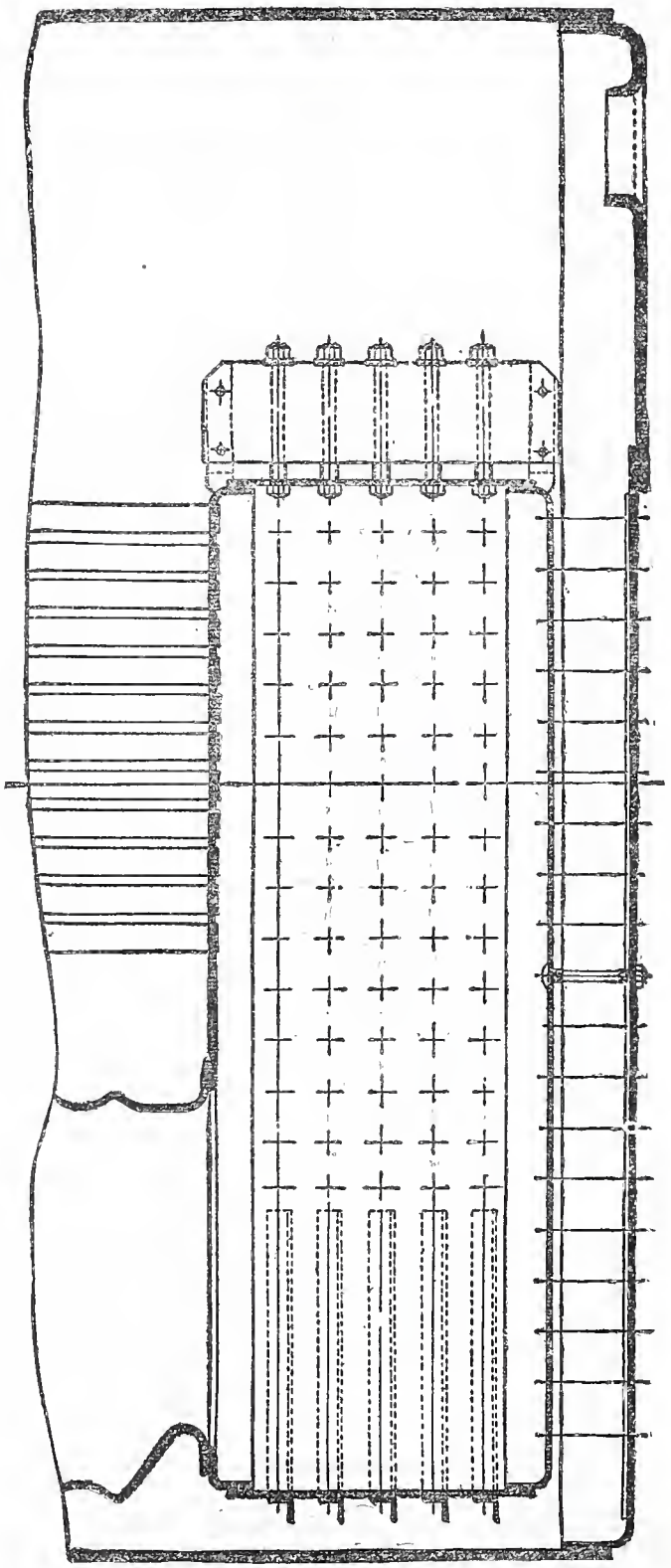
The thickness of tube sheet and back plate may be materially reduced from what would be required when tube sheet and back plate take full compressive load, providing that combustion chamber is well stayed to take full load at the bottom by screw stays or girders of plates and angles.



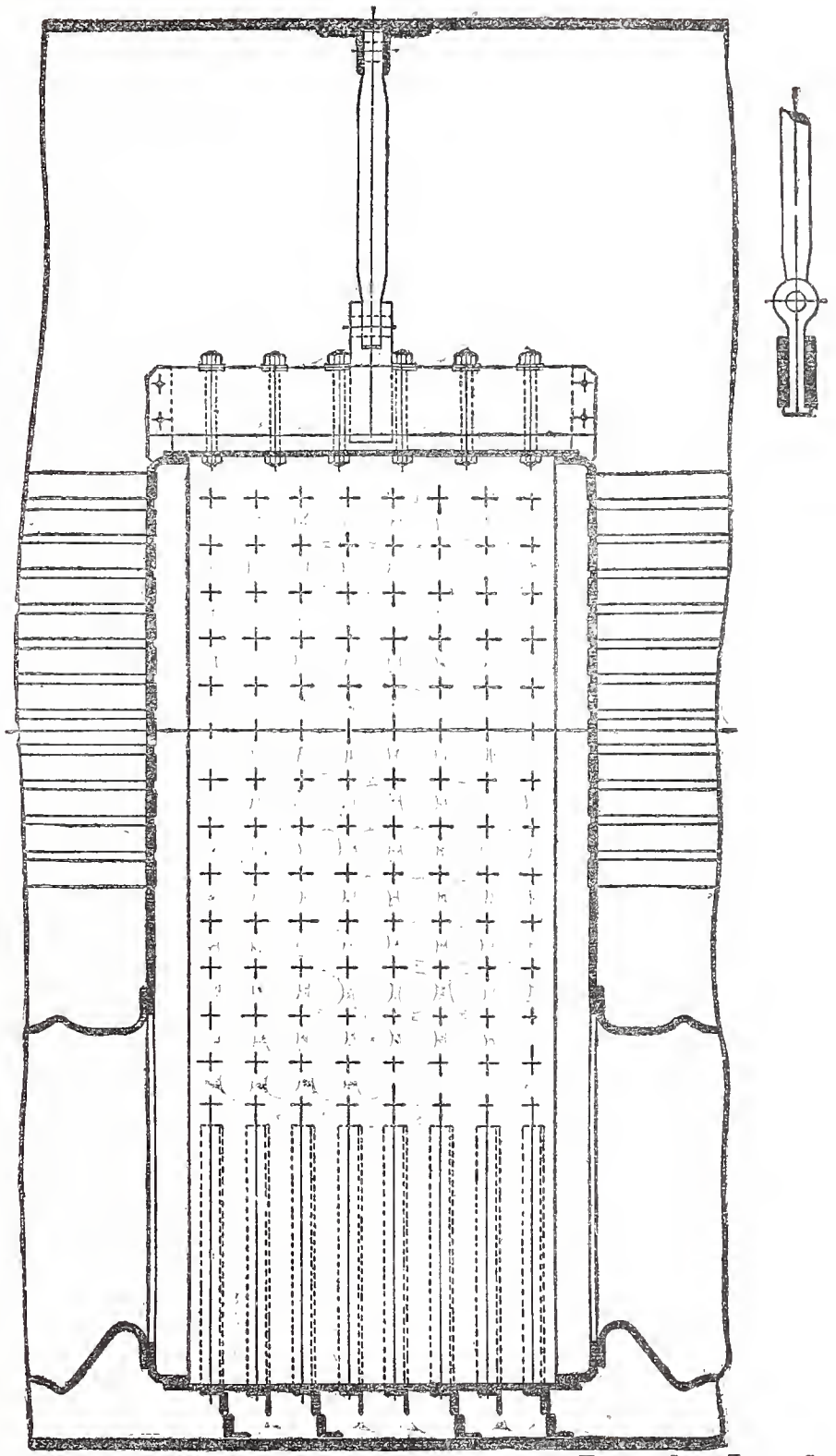
No. 3.—Nearly Whole Compressive Load Taken off Tube Sheet.

Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces, and no boiler should be built having top stays as shown without having the bottom stays of equal strength.



No. 4.—Tube Sheet and Back Plate Get Full Load, and Therefore Should be Heavy Enough to Withstand Such.



No. 5.—Tube Sheets Each Take Part of Compressive Load, the Hanging Stays Taking Care of the Other Part.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces.

In this case the thickness of the tube sheets may be materially reduced from what would be required when tube sheets together take full compressive load. (Sec. 4418, R. S.)

FURNACES.

13. The tensile strength of steel used in the construction of corrugated or ribbed furnaces shall not exceed 67,000 and be not less than 54,000 pounds; and in all other furnaces the minimum tensile strength shall be not less than 58,000 and the maximum not more than 67,000 pounds. The minimum elongation in 8 inches shall be 20 per cent.

All corrugated furnaces having plain parts at the ends not exceeding 9 inches in length (except flues especially provided for), when new, and made to practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$P=\frac{C\times T}{D}$$

LEEDS SUSPENSION BULB FURNACE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than five-sixteenths of an inch.
D=mean diameter in inches.
C=17,300, a constant, determined from an actual destructive test under the supervision of the board, when corrugations are not more than 8 inches from center to center and not less than $2\frac{1}{4}$ inches deep.

MORISON CORRUGATED TYPE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than five-sixteenths of an inch.
D=mean diameter in inches.
C=15,600, a constant, determined from an actual destructive test under the supervision of the Board of Supervising Inspectors, when corrugations are not more than 8 inches from center to center and the radius of the outer corrugations is not more than one-half of the suspension curve.

[In calculating the mean diameter of the Morison furnace, the least inside diameter plus 2 inches may be taken as the mean diameter, thus—

Mean diameter=least inside diameter+2 inches.]

DEIGHTON CORRUGATED TYPE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than five-sixteenths of an inch.

Where D=mean diameter in inches.
C=15,600, a constant, when corrugations are not more than 8 inches from center to center and not less than $1\frac{1}{2}$ inches deep.

FOX TYPE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than five-sixteenths.
D=mean diameter in inches.
C=14,000, a constant, when corrugations are not more than 8 inches from center to center and not less than $1\frac{1}{2}$ inches deep.

PURVES TYPE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than seven-sixteenths.
D=least outside diameter in inches.
C=14,000, a constant, when rib projections are not more than 9 inches from center to center and not less than $1\frac{3}{8}$ inches deep.

BROWN TYPE.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than five-sixteenths.
D=least outside diameter in inches.
C=14,000, a constant (ascertained by an actual destructive test under the supervision of this board), when corrugations are not more than 9 inches from center to center and not less than $1\frac{3}{8}$ inches deep.

PLUG FOR CORRUGATED AND RIBBED FURNACES.

The thickness of corrugated and ribbed furnaces shall be ascertained by actual measurement. The manufacturer shall have said furnaces drilled for a three-eighths inch pipe tap and fitted with a screw plug that can be removed by the inspector when taking this measurement. For the Brown and Purves furnaces the holes shall be in the center of the second flat; for the Morison, Fox, and other similar types, in the center of the top corrugation, at least as far in as the fourth corrugation from the end of the furnace.

TYPE HAVING SECTIONS 18 INCHES LONG.

$$P=\frac{C\times T}{D}$$

Where P=pressure in pounds.
T=thickness in inches, not less than seven-sixteenths.

Where D=mean diameter in inches.
C=10,000, a constant, when corrugated by sections not more than 18 inches from center to center and not less than $2\frac{1}{2}$ inches deep, measuring from the least inside to the greatest outside diameter of the corrugations and having the ends fitted one into the other and substantially riveted together, provided that the plain parts at the ends do not exceed 12 inches in length.

ADAMSON TYPE.

When plain horizontal flues are made in sections not less than 18 inches in length, and not less than five-sixteenths of an inch thick, and flanged to a depth of not less than three times the diameter of rivet holes plus the radius at furnace wall (inside diameter of furnace), the thickness of the flanges shall be as near the thickness of the body of the plate as practicable.

The radii of the flanges on the fire side shall be not less than three times the thickness of plate.

The distance from the edge of the rivet hole to the edge of the flange shall be not less than the diameter of the rivet hole, and the diameter of the rivets before driven shall be at least one-fourth inch larger than the thickness of the plate.

The depth of the ring between the flanges shall be not less than three times the diameter of the rivet holes, and the ring shall be substantially riveted to the flanges. The fire edge of the ring shall terminate at or about the point of tangency to the curve of the flange, and the thickness of the ring shall be not less than one-half inch.

The pressure allowed shall be determined by the following formula:

ADAMSON FURNACES IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH.

$$P=\frac{57.6}{D}\left[(18.75\times T)-(1.03\times L)\right]$$

Where P=working pressure in pounds per square inch.
D=outside diameter of furnace in inches.
L=length of section in inches.
T=thickness of plate in sixteenths of an inch.

Example.

Given a furnace 44 inches in diameter, 48 inches in length, and one-half of an inch thick. Substituting values in formula, we have

$$P=\frac{57.6}{44}\left[(18.75\times 8)-(1.03\times 48)\right]=$$

$$1.309\ \ (150-49.44)=131\ \text{pounds.}$$

SPHERICAL-TOP FURNACES.

Thickness and working pressure of furnaces of 20 inches in diameter and over, when tops are portions of spheres and made in one plate, shall be determined by the following formula:

$$T=\frac{P\times R}{10,000}+0.12$$

Where P=working pressure in pounds.
T=thickness of plate in inches when constructed of one plate.
R=radius of curvature in inches.
%=efficiency per cent of riveted joint when end of furnace is constructed of more than one plate. the thickness will be % T.

Example.

Required the thickness of a spherical convex furnace made in one sheet. Working pressure, 125 pounds per square inch; radius of curvature, 34 inches. Substituting values,

$$T=\frac{125\times 34}{10{,}000}+0.12=0.545.$$

If the end of the furnace is constructed of more than one plate and efficiency per cent of riveted joint is 75.

$$T=\frac{0.545}{0.75}=0.72 \text{ of an inch.}$$

Solving for P, we have

$$P=\frac{(T-0.12)\times 10{,}000}{R}.$$

Required the working pressure when end of furnace is constructed of a single plate. Thickness, 0.545 of an inch; radius of curvature, 34 inches. Substituting values and solving,

$$P=\frac{(0.545-0.12)\times 10{,}000}{34}=125 \text{ pounds.}$$

PLAIN CIRCULAR RIVETED FLUES, FURNACES, AND CONE TOPS MADE IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH AND NOT LESS THAN FIVE-SIXTEENTHS OF AN INCH THICK.

Cylindrical riveted flues and furnaces made in sections of not less than 18 inches in length fitted one into the other and substantially riveted, combustion chambers for vertical submerged tubular boilers in the shape of a frustum of a cone, constructed to a practically true circle, shall be allowed a steam pressure according to the following formula:

$$P=\frac{51.5}{D}\left[(18.75\times T)-(1.03\times L)\right]$$

Where P=working pressure in pounds per square inch.
D=outside diameter of furnaces in inches, or outside *mean* diameter of cone top in inches.
L=length of section or flue in inches.
T=thickness of furnace or cone top in sixteenths of an inch, not to be less than five-sixteenths of an inch.

When diameter of plain furnaces and flues used in vertical type of boilers or mean diameter of cone tops exceeds 42 inches, they shall be deemed a flat surface and must be stayed in accordance with rules governing flat surfaces. If a greater working pressure than given by formula is desired for mean diameters under 42 inches, the flues or cone tops shall be substantially stayed for such additional pressure.

Example.

Given a furnace 26 inches in diameter, 28 inches in height, and five-sixteenths of an inch thick. A steam pressure of 175 pounds is desired.

Substituting values in formula,

$$P=\frac{51.5}{26}\left[(18.75\times 5)-(1.03\times 28)\right]=128 \text{ pounds.}$$

175—128.5, an excess of 46.5 pounds, therefore furnace shall be braced.

Substituting 46.5 for working pressure, W. P. in formula,

$$\text{Working pressure, W. P.}=\frac{C\times T^2}{P^2}.$$

Solving for P^2,

$$P^2=\frac{112\times 5^2}{46.5},$$

$$P=\sqrt{60.21}=7.7$$

Pitch of $7.7\times 7.7=59.29$ area.

To determine size of stay bolt. Area multiplied by pressure per square inch equals total stress on stay. Thus, $59.29\times 46.5=2{,}756.985$ pounds pressure on the plate. Thus, 2,756.985 divided by 6,000= 0.4594 area of stay bolt, practically a thirteen-sixteenths of an inch stay bolt taken at root of thread. (Sec. 4418, R. S.)

FLUES.

PLAIN, LAPWELDED STEEL FLUES, 7 TO 18 INCHES DIAMETER.

14. Working pressures and corresponding minimum thicknesses of wall for long, plain, lapwelded and seamless steel flues, 7 to 18 inches diameter, subjected to external pressure only, shall be determined by the following table and formula:

Outside diameter of flue.	Working pressure in pounds per square inch.						
	100	120	140	160	180	200	220
	Thickness of flue in inches. Safety factor, 5.						
Inches.							
7	0.152	0.160	0.168	0.177	0.185	0.193	0.201
8	.174	.183	.193	.202	.211	.220	.229
9	.196	.206	.217	.227	.237	.248	.258
10	.218	.229	.241	.252	.264	.275	.287
11	.239	.252	.265	.277	.290	.303	.316
12	.261	.275	.289	.303	.317	.330	.344
13	.283	.298	.313	.328	.343	.358	.373
14	.301	.320	.337	.353	.369	.385	.402
15	.323	.343	.361	.378	.396	.413	.430
16	.344	.365	.385	.404	.422	.440	.459
17	.366	.389	.409	.429	.448	.468	.488
18	.387	.412	.433	.454	.475	.496	.516

Thicknesses in this table were calculated by formula:

$$T=\frac{[(F\times P)+1{,}386]D}{86{,}670}$$

Where D=outside diameter of flue in inches.
T=thickness of wall in inches.
P=working pressure in pounds per square inch.
F=factor of safety.

This formula is applicable to lengths greater than six diameters of flue, to working pressures greater than 100 pounds, to outside diameters of from 7 to 18 inches, and to temperatures less than 650° F.

Example.

Required the thickness of a flue 10 inches in diameter; working pressure, in pounds per square inch, 200; factor of safety, 5. Substituting and solving:

$$T=\frac{[(5\times 200)+1{,}386]10}{86{,}670}=0.275 \text{ of an inch.}$$

To determine working pressure, diameter and thickness being given:

$$P=\frac{(T\times 86{,}670)-(1{,}386\times D)}{D\times F}$$

Where D=outside diameter of flue in inches.
T=thickness of wall in inches.
P=working pressure in pounds per square inch.
F=factor of safety.

Example.

Required the working pressure of a flue 12 inches outside diameter, 0.375 of an inch thick; factor of safety is 5.
Substituting and solving:

$$P=\frac{(.0375\times 86{,}670)-(1{,}386\times 12)}{12\times 5}=264.4 \text{ pounds pressure.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED FLUES OVER 6 AND NOT OVER 18 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

When flues are constructed of plates made in sections and efficiently riveted together, not less than 24 inches in length, minimum thickness, 0.25 of an inch, over 6 and not exceeding 18 inches in diameter, the working pressure shall be determined by the following formula:

$$P=\frac{8{,}100\times T}{D}$$

Where P=working pressure in pounds per square inch.
T=thickness in inches.
D=outside diameter in inches.

Example.

Required the working pressure of a flue 13 inches outside diameter, 0.33 of an inch thick.

Substituting values and solving:

$$P=\frac{8{,}100\times 0.33}{13}=205 \text{ pounds.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED, SEAMLESS, OR LAPWELDED FLUES OVER 18 AND NOT OVER 28 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

The working pressure allowable on riveted, seamless, or lapwelded flues over 18 inches in diameter up to and including 28 inches in diameter, made in sections not less than 24 inches in length, efficiently riveted together, sections not to exceed 3½ times the diameter of the flue, when subjected to external pressure only, shall be determined by the following formula:

$$P=\frac{51.5}{D}\left[(18.75\times T)-(L\times 1.03)\right]$$

Where P=working pressure in pounds per square inch.
D=outside diameter of flue in inches.
L=length of flue in inches, not to exceed 3½ diameters of flue.
T=thickness of wall in sixteenths of an inch.

Example.

Required the working pressure of a flue 19 inches outside diameter, 0.4375 of an inch thick, length 66 inches.

Substituting values and solving:

$$P=\frac{51.5}{19}\left[(18.75\times 7)-(66\times 1.03)\right]=171 \text{ pounds pressure.}$$

When lapwelded or seamless flues over 5 inches in diameter are used in externally fired boilers over 20 feet in length, they may be allowed to be made in two pieces joined together by a standard screw-pipe coupling or sleeve. When this form of flue is used on more than one flue in a boiler, the couplings or sleeves shall not be allowed to come opposite, and the distance measured between any such flues and between any such flues and the shell shall be made by measuring between the plates in the flues and the plates in the shell. It shall be the duty of the inspectors to see that the flues are well screwed into the couplings or sleeves so as to have the ends of flues as near together as is practicable.

Inspectors are required at each annual inspection to carefully inspect the flues of every boiler and subject them to the hammer test where possible or practicable in order that deterioration of material may be detected. If such test indicates thin material, the doubtful place shall be drilled and the material carefully gauged in order that the safe pressure may be determined; or if the flue is found to deviate from the form of a practically true circle, the pressure shall be reduced accordingly. The efficiency and workmanship of the riveted seams shall also be carefully observed at all inspections. (Sec. 4418, R. S.)

TUBES.

15. Lapwelded and seamless tubes, used in boilers whose construction was commenced after June 30, 1910, having a thickness of material according to their respective diameters, shall be allowed a working pressure as prescribed in the following table, provided they are deemed safe by the inspectors. Where heavier material is used, pressure may be allowed as prescribed in first formula under the heading "Flues," for determining the working pressure of lapwelded flues. Any length of tube is allowable.

Outside diameter.	Thickness of material.	Maximum pressure allowed.
Inches.	*Inch.*	*Pounds.*
2	0.095	427
2¼	.095	380
2½	.109	392
2¾	.109	356
3	.109	327
3¼	.120	332
3½	.120	308
3¾	.120	282
4	.134	303
4½	.134	238
5	.148	235
6	.165	199

LAPWELDED BOILER TUBES UP TO AND INCLUDING 4 INCHES IN DIAMETER.

All lapwelded tubes shall be made of charcoal iron, or mild steel, made by any process.

American ingot iron, manufactured by the American Rolling Mill Co., Middletown, Ohio, shall be accepted as meeting the provisions for lapwelded tubes.

SURFACE INSPECTION.

Tubes shall be free from defective welds, cracks, blisters, scale, pits, and sand marks.

TESTS.

The following tests shall be made before shipment by the manufacturer:

(*a*) A test piece 2 inches in length cut from a tube shall stand being flattened by hammering until the sides are brought parallel and separated by a distance not greater than one-third the outside diameter of the tube, without showing cracks or flaws, the weld being 45° from the bend.

(*b*) A second tube shall have a flange turned over at right angles to the body of the tube and shall have a width equal to three-eighths of an inch. Tubes less than 3 inches in diameter shall only be required to have a flange turned equal to one-eighth of the diameter of the tube. This test shall not be applied to threaded stay tubes.

All the work shall be done cold.

Each tube shall stand an internal hydrostatic pressure of 1,000 pounds per square inch and shall be struck near both ends while under pressure with a 2-pound hammer or its equivalent without showing signs of weakness or defects.

All steel tubes, except those made of open-hearth steel, shall have the ends properly annealed by the manufacturer before shipment.

All tubes shall stand expanding, flanging over on the tube plate, and beading without flaws, cracks, or opening at the weld, except threaded stay tubes.

LAPWELDED BOILER TUBES OVER 4 INCHES UP TO AND INCLUDING 30 INCHES IN DIAMETER.

All lapwelded boiler tubes over 4 inches in diameter, up to and including 30 inches in diameter, shall be made of wrought iron or mild steel, made by any process.

American ingot iron, manufactured by the American Rolling Mill Co., Middletown, Ohio, shall be accepted as meeting the provisions for lapwelded tubes.

(*a*) A test piece, 2 inches in length, cut from a tube, shall stand being flattened by hammering until the sides are brought parallel and separated by a distance not greater than one-third the outside diameter of the tube, without showing cracks or flaws, with the weld being 45° from the bend.

Each tube shall stand an internal hydrostatic pressure of 500 pounds per square inch and shall be struck near both ends while under pressure with a 2-pound hammer or its equivalent without showing signs of weakness or defects.

All steel tubes, except those made of open-hearth steel, shall have ends properly annealed by the manufacturer before shipment.

All tubes shall stand drilling, riveting, and calking, and work necessary to install them into the tube head without showing any weakness or defects.

SEAMLESS STEEL BOILER TUBES.

MATERIAL.

The steel shall be made by the open-hearth process.

SURFACE INSPECTION.

Tubes shall be free from all surface defects. The defects to be particularly avoided in seamless tubes are tears, snakes, checks, slivers, scratches, laps, pits, rings, and sinks.

All seamless steel cold-drawn tubes shall be annealed as a final process. One or more tubes shall be selected at random from each charge of annealing furnace, and coupons cut from same for testing.

(*a*) A piece 3 inches long cut from the first tube shall stand being flattened by hammering until the sides are brought parallel and separated by a distance not greater than one-third the outside diameter of the tube, without showing cracks or flaws.

(*b*) A flange shall be turned all around the end of the tube to a width equal to three-eighths of an inch beyond the outside body of the tube. Tubes less than 3 inches in diameter shall only be required to have a flange turned equal to one-eighth of the diameter of the tube. This test shall not be applied to threaded stay tubes.

Tests (*a*) and (*b*) shall be done cold.

Where hot-finished tubes are furnished, the tubes shall pass the same manipulating tests as cold-drawn tubes and shall be subject to the same conditions as to gauge, but do not have to be annealed.

Each tube shall be subjected to an internal hydrostatic pressure of 1,000 pounds per square inch without showing signs of weakness or defects.

All tubes, except threaded stay tubes, shall stand expanding, flanging over on the tube plate, and beading without flaw or crack.

All tubes shall be carefully gauged and shall not be less than the specified thickness.

No tube increased in thickness by welding one tube inside of another shall be allowed for use, but the ends of boiler tubes may be welded on for the purpose of making repairs, or new tubes may be welded for the purpose of making them longer: *Provided*, That such welding is not made by any process of autogenous welding. (Secs. 4405, 4418, R. S.)

STATEMENT OR CERTIFICATE OF MANUFACTURER OF BOILER TUBES.

When the manufacturers of boiler tubes file with the Supervising Inspector General a certificate duly sworn to that all tubes manufactured by them will stand the tests and meet all the requirements of the foregoing rule, they shall be accepted by inspectors of this service, and no other affidavit will be required. (Secs. 4405, 4418, R. S.)

STAYS.

16. The maximum working pressure in pounds allowable per square inch of cross-sectional area for stays used in the construction of marine boilers where same are accurately fitted normal to supported surfaces and properly secured shall be ascertained by the following formula:

$$P = \frac{A \times C}{a}$$

Where P = working pressure in pounds.
A = least cross-sectional area of stay in inches.
a = area of surface supported by one stay in inches.
C = a constant.
C = 9,000 for tested steel stays 1 inch and upward in diameter when such stays are not forged or welded. The ends may be upset to a sufficient diameter to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay. All such stays after being upset shall be thoroughly annealed.
C = 8,000 for a tested Huston or similar type of brace, the cross-sectional area of which exceeds 5 square inches.
C = 7,000 for such tested braces when the cross-sectional area is not less than 1.227 and not more than 5 square inches, provided such braces are prepared at one heat from a solid piece of plate without welds.
C = 7,500 for wrought-iron stays 1 inch and upward in diameter when made of the best quality of refined iron. The ends may be upset to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay. Such stays may be welded.

Where C=6,000 for welded crowfoot stays when made of best quality of refined wrought iron, and for all stays not otherwise provided for when made of the best quality of refined iron or of steel without welds.

Example.

Required the working pressure of a stay 1 inch in diameter, pitched 6 inches by 6 inches center to center.

$$\text{Working pressure}=\frac{(1\times1\times0.7854)\times6{,}000}{6\times6}=130.9 \text{ pounds.}$$

Stay bolts and stays made of the best quality of refined wrought iron may be welded. The lengthening of steel stays by welding shall not be allowed.

TO DETERMINE THE AREAS OF DIAGONAL AND GUSSET STAYS.

Multiply the area of a direct stay required to support the surface by the slant or diagonal length of the stay; divide this product by the length of a line drawn at right angles to surface supported to center of palm of diagonal stay. The quotient shall be the required area of the diagonal stay.

$$A=\frac{a\times L}{l}$$

Where A=sectional area of diagonal stay.
a=sectional area of direct stay.
L=length of diagonal stay.
l=length of line drawn at right angles to boiler head or surface supported to center of palm of diagonal stay.

Given diameter of direct stay=1 inch, a=0.7854, L=60 inches, l=48 inches, substituting and solving,

$$A=\frac{0.7854\times60}{48}=0.981 \text{ sectional area.}$$

Diameter=1.11 inches=$1\frac{1}{8}$ inches.

The sectional area of gusset stays, when constructed of triangular right-angled web plates secured to single or double angle bars along the two sides at right angles, shall be determined by formula for diagonal stays, and shall be not less than 10 per cent greater than would be necessary for a diagonal bolt stay.

The diameter of a screw stay shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

For all stays the least sectional area shall be taken in calculating the strees allowable.

All screw stay bolts shall be drilled at the ends with a three-sixteenths-inch hole to at least a depth of one-half inch beyond the inside surface of the sheet. Stays through laps or butt straps may be drilled with larger hole to a depth so that the inner end of said larger hole shall not be nearer than the thickness of the boiler plates from the inner surface of the boiler. Hollow-rolled screw stay bolts may be used.

Flexible stay bolts that are made with a ball in socket on one end, the socket screwed into the outside sheet and covered with a removable cap and bolt screwed into the inside sheet and riveted over, may be used for staying flat surfaces without being drilled with a telltale hole.

Holes for screw stays shall be tapped fair and true, and full thread.

Screw stay bolts of a greater length than 24 inches will not be allowed in any instance, unless the ends of said bolts are fitted with nuts.

The ends of stays which are upset to include the depth of thread shall be thoroughly annealed after being upset.

The sectional area of pins to resist double shear and bending, accurately fitted and secured in crowfeet, sling, and similar stays, shall be at least equal to eighth-tenths of the required sectional area of the brace. Breadth across each side and depth to crown of eye shall be not less than 0.35 of diameter of pin. In order to compensate for inaccurate distribution the forks shall be proportioned to support two-thirds of the load, thickness of forks to be not less than 0.66 of the diameter of pin.

The combined sectional area of rivets used in seeuring tee irons and crowfeet to shell, said rivets being in tension, shall be not less than the required sectional area of brace. To insure a well-proportioned rivet point, rivets shall be of sufficient length to completely fill the rivet holes and form a head equal in strength to the body of the rivet. All rivet holes shall be drilled. Distance from center of rivet hole to edge of tee irons, crowfeet, and similar fastenings shall be so proportioned that the net sectional areas through sides at rivet holes shall equal the required rivet section. Rivet holes shall be slightly countersunk in order to form a fillet at point and head.

When sling stays are connected by pins to angles secured to shell (see figs. 1 and 2 in sec. 12 of Rule II), said angles shall be of sufficient depth to resist shear. Section to resist shear shall be determined by the following formula:

$$A = D \times 2T$$

$$D = \frac{A}{2T}$$

Where A=sectional area of pin.
D=depth from edge of pinhole to end of leg.
2T=thickness of two angles.

Example.

Diameter of sling stay, 2 inches. Diameter of pin, 1.6 inches. Thickness of angle, seven-eighths of an inch. Required the depth from edge of pinhole to end of leg.

Substituting values and solving:

$$D = \frac{0.7854 \times 1.6 \times 1.6}{2 \times 0.875} = 1.15 \text{ inches.}$$

Minimum diameter of rivets shall be found as follows:

$$\text{Minimum diameter} = \sqrt{\frac{\text{load}}{0.7854 \times 12{,}000 \times N}}$$

Where N equals number of rivets. Rivets shall be staggered in each leaf.

TESTS OF BARS FOR STAYS AND BRACES.

All steel bars to be used as stays or braces in marine boilers and allowed a stress of 7,000, 8,000, or 9,000 pounds per square inch of section, tested by the United States inspectors at the mills where the material is manufactured, shall be tested in the following manner: There shall be taken from each heat two pieces for tensile tests and two pieces for bending tests. The full-size bars within the capacity of the testing machine may be used for tensile tests. Where the full size of the bar is too large for the capacity of the testing machine, the bar may be reduced in size to meet such capacity. To facilitate and insure accurate tests, all bars for tensile and bending tests may be reduced in size. The minimum tensile strength of each test piece shall be not less than 58,000 pounds per square inch of section and each test piece that has been reduced in size shall show an elongation of at least 28 per cent in 2 inches. Where the full size of the bar has been used for testing, the test piece shall show an elongation of at least 25 per cent in 8 inches. When the tensile strength of the test piece is more than 63,000 pounds per square inch of section, each test piece that has been reduced in size shall show an elongation of at least 26 per cent in 2 inches. Where the full size of the bar has been used for testing, each test piece shall show an elongation of at least 22 per cent in 8 inches. The pieces for the bend test shall be bent cold to a curve, the inner radius of which is equal to one and one-half times the diameter of the bar without flaws or cracks. Should any such test bar fail in either the tensile or bending test, no bars from such heat shall be allowed to be used in the construction of any marine boiler. Where a heat of steel bars has been passed by an inspector, separate lots of bars from such heat may be furnished to different boiler manufacturers upon a certificate from the mill that the bars were made from such accepted heat.

Boiler manufacturers desiring to use tested steel stays or braces shall be required to furnish the inspectors with the following form of affidavit, duly filled in:

[Form 937.]

STATE OF ———, *County of* ———, *ss:*

Personally appeared before me, a notary public for and in the county of ——— and State of ———, Mr. ——— ———, who, being first duly sworn, deposes and says that he is the ——— of the steam boiler works situated at ———, and known as the ———, and that the lot or lots of steel bars from which the test bars were taken and tested by the inspector on the —— day of ———, 19—, and allowed for use in the steam boiler– to be constructed for the steamer ———, and to be allowed a strain not to exceed —— pounds per square inch of section as a working steam pressure, will be used in the construction of the boiler– for the steamer ———, and no material for any braces, stays, or stay bolts required to carry a strain equal to ——— pounds per square inch of section will be used as braces, stays, or stay bolts in the construction of the boiler– for the said steamer unless tested by the inspector and approved by him in accordance with the requirements of law.

——— ———,

——— ———.

Sworn to and subscribed before me this —— day of ———, 19—.

[NOTARY'S SEAL.]

——— ———,

Notary Public.

(Secs. 4405, 4418, R. S.)

TOPS OF COMBUSTION CHAMBERS AND BACK CONNECTIONS.

17. Formula for girders over back connection and other flat surfaces:

$$\text{Working pressure}=\frac{C\times d^2\times T}{(W-P)\times D\times L}$$

Where W=extreme width of combustion box in inches.
P=pitch of supporting bolts in inches.
D=distance between girders from center to center in inches.
L=length of girder in feet between supports.
d=depth of girder in inches.
T=thickness of girder in inches.
C=550 when the girder is fitted with 1 supporting bolt.
C=825 when the girder is fitted with 2 or 3 supporting bolts.
C=917 when the girder is fitted with 4 or 5 supporting bolts.
C=963 when the girder is fitted with 6 or 7 supporting bolts.
C=990 when the girder is fitted with 8 or more supporting bolts.

Example.

Given, W=34 inches, P=7.5 inches, D=7.75 inches, L=2.927 feet, d=7.5 inches, T=2 inches, C=825, then, substituting in formula,

$$\text{Working pressure}=\frac{825\times 7.5\times 7.5\times 2}{(34-7.5)\times 7.75\times 2.927}=154.3 \text{ pounds.}$$

(Sec. 4418, R. S.)

FLAT SURFACES.

18. All stayed surfaces formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

$$\text{Working pressure}=\frac{C\times T^2}{P^2}$$

Where P=pitch of stays in inches when equally spaced in both directions.

When pitches of stays are unequal, $\frac{A^2+B^2}{2}$ is to be taken instead of P^2

Where A=the pitch of stays in inches in one row.
B=distance in inches between two rows of stays.
T=thickness of plates in sixteenths of an inch.
C=112 for screw stays with riveted heads, plates seven-sixteenths of an inch thick and under.
C=120 for screw stays with riveted heads, plates above seven-sixteenths of an inch thick.
C=120 for screw stays with nuts, plates seven-sixteenths of an inch thick and under.

Where C=125 for screw stays with nuts, plates above seven-sixteenths of an inch thick and under nine-sixteenths of an inch.

C=135 for screw stays with nuts, plates nine-sixteenths of an inch thick and above.

C=160 for stays fitted with washers or doubling strips which have a thickness of at least 0.5 of the thickness of the plate and a diameter of at least 0.5 of the greatest pitch of the stay, riveted to the outside of the plates, and stays having one nut inside of the plate and one nut outside of the washer or doubling strip. For T take 72 per cent of the combined thickness of the plate and washer or plate and doubling strip.

C=175 for stays with double nuts, having one nut on the inside and one nut on the outside of the plate, without washers or doubling plates.

C=200 for stays fitted with doubling plates which have a thickness equal to at least 0.5 of the thickness of the plate reinforced, and covering the full area braced (up to the curvature of the flange, if any), riveted to either the inside or outside of the plate, and stays having one nut outside and one inside of the plates. Washers or doubling plates to be substantially riveted. For T take 72 per cent of the combined thickness of the two plates.

C=200 for stays with plates stiffened with tees or angle bars having a thickness of at least two-thirds the thickness of plate and depth of webs at least one-fourth of the greatest pitch of the stays, and substantially riveted on the inside of the plates, and stays having one nut inside bearing on washers fitted to the edges of the webs that are at right angles to the plate. For T take 72 per cent of the combined thickness of web and plate. (Sec. 4418, R. S.)

NAME PLATES.

19. There shall be fastened to each boiler a plate containing the name of the manufacturer of the material, the place where manufactured, the tensile strength, the name of the builder of the boiler, when and where built.

The date of the building of the boiler or boilers shall be determined by the month and year of issue of the first certificate of inspection which covers the boiler or boilers in question: *Provided*, That the boiler or boilers have not been used for any purpose previous to the inspection. (Sec. 4418, R. S.)

FUSIBLE PLUGS.

20. Fusible plugs for use in boilers of steam vessels under the jurisdiction of the Steamboat-Inspection Service shall be made of a bronze casing with the bore tapering continuously and evenly from end to end, and filled from end to end with tin not less than 99.7 per cent pure and to contain not more than 0.1 per cent of lead and not more than 0.1 per cent of zinc. The small end of the bore may be countersunk not more than one thirty-second of an inch in depth

and width, but no recess, thread, or cavity other than this countersink shall be allowed.

Fusible plugs, except those which are hereafter provided for, shall have an external diameter of not less than three-fourths of an inch pipe tap, and the filling shall be at least one-half of an inch in diameter at the smaller end, and shall have a larger diameter at the opposite end of the plug: *Provided, however*, That all fusible plugs fitted in boilers carrying a steam pressure exceeding 150 pounds to the square inch may be reduced at the smaller end of the filling to five-sixteenths of an inch in diameter.

Every boiler other than boilers of the water-tube type shall be fitted with at least two fusible plugs as described above, and located as follows:

Upright boilers shall be fitted with two fusible plugs of an external diameter of not less than three-eighths of an inch pipe tap, the filling to be at least one-fourth of an inch in diameter at the smaller end and shall have a greater diameter at the opposite end. The fusible plugs shall be located in separate tubes not more than 2 inches below the lowest gauge cock.

Externally heated cylindrical boilers, with flues, shall have one plug in the top of the upper flue, not more than 4 feet from the back end of the flue, and shall also have a plug fitted to the shell of the boiler immediately below the fire line, and not less than 4 feet from the front end: *Provided, however*, That when the flues are not more than 6 inches in diameter fusible plugs of not less diameter than three-eighths of an inch pipe tap may be used in such flues.

Fire-box, scotch, and other types of shell boilers not specially provided for, having a combustion chamber common to all furnaces, shall have two plugs fitted to the crown sheet of the combustion chamber at or near the center of the crown sheet and not more than 12 inches apart.

Double-end boilers with separate combustion chambers, each of which combustion chambers is common to all furnaces in its own end of the boiler, shall have two plugs fitted to the crown sheet of each combustion chamber at or near the center of the crown sheet, and not more than 12 inches apart.

Boilers fitted with a separate combustion chamber for each individual furnace shall be fitted with a fusible plug in the center of the crown sheet of each combustion chamber.

Boilers of types not herein provided for shall be fitted with at least two fusible plugs of such dimensions and located in such parts of the boiler as will, in the judgment of the local inspectors, best meet the purposes for which they are intended.

Fusible plugs shall be renewed at each annual inspection, but in cases where the plugs were installed or renewed not more than 6 months prior to the annual inspection, they may be allowed until the next following annual inspection or for a period not to exceed 18 months. In such cases, however, the inspector shall satisfy himself at the annual inspection that the plugs are in such condition as to warrant their continued use until the next annual inspection, after which the plugs shall be renewed at each and every annual inspection.

Fusible plugs shall be so fitted that the smaller end of the filling is exposed to the fire, and shall be at least 1 inch higher on the water side than the plate or flue in which they are fitted.

Notwithstanding anything which may be contained in this rule, fusible plugs shall be so fitted that the end of the filling on the water end of the plug is not less than 1 inch above the dangerous low-water level.

Each manufacturer of fusible plugs shall number all plugs in accordance with the number of the heat from which the plugs were filled. For instance, the first pouring shall be number 1, and all plugs filled from this heat shall be numbered 1; the next pouring shall be numbered 2, and all the plugs filled from this heat shall be numbered 2, etc.

The heat number shall be plainly stamped on each end of filling with numbers not less than $\frac{1}{12}$ inch in height.

Manufacturers of fusible plugs shall furnish the Supervising Inspector General a sample plug from each heat for examination and test, but where more than 250 plugs are poured from the same heat, a sample plug shall be furnished for each 250 plugs or fraction thereof. The samples furnished shall bear the same number for any one heat and shall represent the heat from which the sample is poured.

In transmitting samples of fusible plugs to the Supervising Inspector General, the fusible plugs and the letters of transmittal shall be addressed as follows: "Supervising Inspector General, Steamboat-Inspection Service, Department of Commerce, Washington, D. C."

One letter of transmittal shall be required for each heat.

In letter of transmittal the following information shall be stated:

Number of heat.

Number of fusible plugs manufactured from the heat.

Number of samples of fusible plugs from the heat transmitted.

Name of manufacturer or initials stamped on casing of plug.

Manufacturers of fusible plugs shall stamp on the larger end or face of the casing their name or initials for identification and shall file with the Supervising Inspector General of the Steamboat-Inspection Service at Washington, D. C., a certificate duly sworn to that such plugs are filled with tin of the character required by this rule and made in accordance therewith.

Following is a general form of affidavit to be followed by manufacturers of fusible plugs:

STATE OF ———, *County of* ———.

I hereby certify, on this ——— day of ———, 191–, that I am ——— ———, of
(State owner or name position.)

the manufactory of ———, at ———, in the State of ———; that all fusible plugs furnished for use in boilers of steam vessels under the jurisdiction of the Steamboat-Inspection Service by the said manufactory will be filled with tin of the character required, and will be made in accordance with the rules and regulations of the Board of Supervising Inspectors, Steamboat-Inspection Service, governing the manufacture of fusible plugs; and that I am authorized to make this certificate.

——— ———.
(Signature of manufacturer.)

Subscribed and ——— to before me this ——— day of ———, 191–.
(Sworn or affirmed.)

(Signature) ——— ———,

[NOTARY'S SEAL.] *Notary Public.*

The certificate shall be executed by some person having authority to make the statements contained therein.

On receipt of a properly executed affidavit by the Supervising Inspector General, the inspectors of the Steamboat-Inspection Service and the merchant marine generally shall be notified. (Secs. 4405, 4418, R. S.)

GAUGE COCKS AND WATER GLASS.

21. All boilers, except flash boilers, shall be supplied with at least one reliable water gauge and at least three gauge cocks attached directly to each boiler. When the gauge glass and gauge cocks are connected to the boilers by a water column there shall be three additional gauge cocks inserted in the head or shell of boiler. The lower gauge cock in boilers more than 48 inches in diameter shall be not less than 4 inches above the top of the flues, tubes, or combustion chambers. In boilers less than 48 inches in diameter the lower gauge cock shall be not less than $2\frac{1}{2}$ inches above the top of the flues, tubes, or combustion chambers. A gauge glass shall be considered a reliable water gauge, and a float such as used on western river steamers shall be considered on such boilers as a reliable water gauge: *Provided*, That when water-tube boilers have an efficient water column connected to the steam drum of said boiler at the top and the water manifold at the bottom, and such water column has a gauge glass and three gauge cocks fitted to same, and also is fitted with a valve or stopcock, both at top and bottom where the column is connected to the boiler, no gauge cocks shall be required in the head or shell of the drums of such water-tube boilers.

Double-end boilers shall have at least three gauge cocks and one water glass at each end.

In vertical boilers or boilers of the water-tube type the location of the lowest gauge cock shall be determined by the local inspectors. (Sec. 4418, R. S.)

STEAM GAUGES.

22. All boilers or sets of boilers shall have attached to them at least one gauge that will correctly indicate a pressure of steam equal to 80 per cent of the hydrostatic pressure applied by the inspectors. (Sec. 4418, R. S.)

SAFETY VALVES.

23. Safety valves when fitted either to the shell of boiler or steam drum may be fitted with internal dry pipes when made of standard steam pipe or of riveted material equal in thickness, and when the combined openings in the dry pipe equal in area at least one and one-half times the opening of the valve.

The areas of all safety valves on boilers contracted for or the construction of which commenced on or after June 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = 0.2074 \times \frac{W}{P}$$

Where a = area of safety valve, in square inches, per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

Where P=absolute pressure per square inch=working gauge pressure+15.

From which formula the areas required per square foot of grate surface in the following table are found by assuming the different values of W and P.

The figures (a) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

Examples.

Boiler pressure=75 pounds per square inch (gauge).

2 furnaces: Grate surface=2(No.)×5 feet 6 inches (long)×3 feet (wide)=33 square feet.

Water evaporated per pound of coal=8 pounds.

Coal burned per square foot grate surface per hour=$12\frac{1}{2}$ pounds.

Evaporation per square foot grate surface per hour=$8\times12\frac{1}{2}$=100 pounds. Hence W=100 and gauge pressure=75 pounds.

From table the corresponding value of a is 0.230 square inch.

Therefore area of safety valve=33×0.23=7.59 square inches.

For which the diameter is $3\frac{1}{8}$ inches nearly.

Boiler pressure=215 pounds.

6 furnaces: Grate surface=6(No.)×5 feet 6 inches (long)×3 feet 4 inches (wide)=110 square feet.

Water evaporated per pound coal=10 pounds.

Coal burned per square foot grate surface per hour=30 pounds.

Evaporation per square foot grate surface per hour=10×30=300 pounds.

Hence W=300, gauge pressure=215, and a=0.270 (from table).

Therefore area of safety valve=110×0.270=29.7 square inches, which is too large for one valve. Use two.

$\frac{29.7}{2}$=14.85 square inches. Diameter=$4\frac{3}{8}$ inches.

To determine the area of a safety valve for boiler using oil as fuel or for boilers designed for any evaporation per hour:

Divide the total number of pounds of water evaporated per hour by any number of pounds of water evaporated per square foot of grate surface per hour (W) taken from, and within the limits of, the table. This will give the equivalent number of square feet of grate surface for boiler for estimating the area of valve. Then apply the table as in previous examples.

Example.

Required the area of a safety valve for a boiler using oil as fuel, designed to evaporate 8,000 pounds of water per hour, at 175 pounds gauge pressure.

Make W=200.

$\frac{8,000}{200}$=40, the equivalent grate surface, in square feet.

For gauge pressure=175 pounds and W=200, from table, a=0.218 square inch. 0.218×40=8.72 square inches, the total area of safety valve required for this boiler, for which the diameter is $3\frac{5}{16}$ inches nearly.

Table of area of safety valves required per square foot of grate surface for different pressures and rates of evaporation.

P, absolute pressure per square inch.	Gauge pressure per square inch.	These figures represent evaporation in pounds per square foot of grate surface per hour (W)=pounds water evaporated per pound coal×pounds coal burned per square foot of grate surface per hour.														
		100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
		The figures below give *a*, the area in square inches required per square foot of grate surface at the above rate of evaporation.														
65	50	0.319	0.383	0.447	0.510	0.574	0.638	0.702	0.765	0.829	0.893	0.956				
70	55	.296	.355	.414	.474	.533	.592	.652	.711	.769	.828	.888				
75	60	.276	.332	.387	.442	.497	.552	.608	.663	.718	.773	.829				
80	65	.259	.311	.363	.415	.466	.518	.570	.622	.674	.726	.778				
85	70	.244	.292	.341	.390	.438	.487	.536	.585	.634	.682	.731				
90	75	.230	.276	.322	.368	.414	.460	.506	.552	.598	.644	.690				
95	80	.218	.262	.305	.349	.392	.436	.479	.523	.567	.610	.654				
100	85	.207	.249	.290	.332	.373	.414	.456	.497	.538	.580	.622				
105	90	.197	.236	.276	.316	.355	.394	.434	.473	.513	.552	.592				
110	95	.188	.226	.264	.301	.339	.377	.414	.452	.489	.527	.565				
115	100	.180	.216	.252	.288	.324	.360	.396	.432	.468	.504	.540				
120	105	.172	.207	.241	.276	.311	.345	.379	.414	.448	.483	.517				
125	110	.166	.199	.232	.265	.298	.331	.364	.397	.431	.463	.497				
130	115	.160	.192	.223	.255	.287	.319	.351	.383	.415	.447	.479				
135	120	.153	.184	.215	.246	.276	.307	.337	.368	.398	.429	.460				
140	125	.148	.177	.207	.237	.266	.296	.325	.355	.385	.414	.444				
145	130	.143	.172	.201	.229	.258	.287	.315	.344	.372	.401	.430				
150	135	.138	.166	.194	.222	.249	.277	.304	.332	.360	.387	.415				
155	140	.134	.160	.187	.214	.241	.268	.294	.321	.348	.375	.401				
160	145	.130	.156	.181	.207	.233	.259	.285	.311	.337	.363	.389				
165	150	.126	.151	.176	.201	.226	.251	.276	.301	.326	.352	.378				
170	155	.122	.146	.171	.195	.219	.244	.268	.292	.317	.341	.366				
175	160	.118	.142	.166	.189	.213	.236	.260	.284	.308	.331	.355				
180	165	.115	.138	.161	.184	.207	.230	.254	.277	.300	.323	.346				
185	170	.112	.135	.157	.179	.202	.224	.247	.269	.291	.314	.336				
190	175	.109	.131	.153	.175	.196	.218	.240	.262	.284	.306	.328				
195	180	.106	.128	.149	.170	.191	.213	.234	.255	.277	.298	.319				
200	185	.104	.124	.145	.166	.187	.207	.228	.249	.270	.290	.310				
205	190	.101	.121	.142	.162	.182	.202	.223	.243	.263	.282	.303				
210	195	.099	.119	.138	.158	.178	.198	.217	.237	.257	.277	.297				
215	200	.096	.116	.135	.154	.173	.193	.212	.231	.250	.269	.289	0.308	0.327	0.347	0.366
220	205	.094	.113	.132	.151	.170	.189	.208	.226	.245	.264	.283	.302	.321	.340	.358
225	210	.092	.110	.129	.147	.166	.184	.203	.221	.240	.258	.276	.295	.314	.332	.350
230	215	.090	.108	.126	.144	.162	.180	.198	.216	.235	.253	.270	.289	.307	.325	.343
235	220	.088	.106	.124	.141	.159	.176	.194	.212	.229	.247	.264	.282	.300	.318	.336
240	225	.086	.104	.121	.138	.155	.173	.190	.207	.225	.242	.259	.276	.294	.311	.329
245	230	.085	.102	.119	.135	.152	.170	.186	.203	.220	.237	.254	.271	.288	.305	.322

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Table of area of safety valves required per square foot of grate surface for different pressures and rates of evaporation—Continued.

P, absolute pressure per square inch.	Gauge pressure per square inch.	These figures represent evaporation in pounds per square foot of grate surface per hour (W)=pounds water evaporated per pound coal×pounds coal burned per square foot of grate surface per hour.														
		100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
		The figures below give *a*, the area in square inches required per square foot of grate surface at the above rate of evaporation.														
250	235	0.083	0.100	0.117	0.133	0.149	0.167	0.183	0.190	0.216	0.233	0.249	0.266	0.282	0.299	0.315
255	240	.081	.098	.114	.130	.146	.163	.179	.195	.211	.228	.244	.261	.277	.293	.309
260	245	.080	.096	.112	.128	.144	.160	.176	.192	.208	.224	.240	.255	.271	.287	.303
265	250	.078	.094	.110	.125	.141	.157	.172	.188	.203	.219	.235	.250	.266	.282	.298
270	255	.077	.092	.107	.123	.138	.153	.169	.184	.199	.215	.230	.245	.261	.276	.291
275	260	.075	.090	.105	.121	.136	.151	.166	.181	.196	.211	.226	.241	.256	.271	.286
280	265	.074	.089	.104	.118	.133	.148	.163	.178	.192	.207	.222	.237	.251	.266	.281
285	270	.073	.087	.102	.116	.131	.146	.160	.175	.189	.204	.218	.233	.247	.262	.276
290	275	.072	.086	.100	.114	.129	.143	.157	.172	.186	.200	.214	.228	.242	.257	.271
295	280	.070	.084	.098	.112	.127	.141	.154	.169	.182	.196	.210	.224	.238	.253	.267
300	285	.069	.083	.096	.110	.124	.138	.151	.166	.179	.193	.207	.221	.235	.249	.263
305	290	.068	.082	.095	.109	.122	.136	.149	.163	.177	.190	.204	.217	.231	.245	.258
310	295	.067	.080	.093	.107	.120	.134	.147	.160	.174	.187	.201	.214	.227	.241	.254
315	300	.066	.079	.092	.105	.118	.132	.145	.158	.171	.184	.197	.210	.223	.237	.250

Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam after being raised from its seat, or any spring-loaded safety valve constructed in any other manner, so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to one-eighth of the diameter of the valve opening; but in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lockup safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve. Whenever the area of a safety valve, as found by the rule of this section, will be greater than that corresponding to 4½ inches in diameter, two or more safety valves, the combined area of which shall be equal at least to the area required, shall be used.

Where escape pipes for safety valves are installed in steam vessels after July 1, 1910, the area of such pipes shall equal the combined area of all safety valves to which such pipes are connected.

Where safety valves are used with beveled seats, the seats shall have an angle of inclination of 45° to the center lines of their axes. Flat-seat safety valves may be used under the formula and table under the heading "Safety valves" in Rule II. The discharge capacity of a flat-seat valve shall be 1.4 times that allowed for a bevel-seat valve.

Hereafter no safety valves having a set-screw arrangement on top of the valve casing, designed to hold the valve down while the hydrostatic pressure is being applied, shall be allowed. On such valves now in use, inspectors shall require the set screws to be taken out and the hole permanently closed. This does not apply to any safety valve whose form of construction is such that the hole for the set screw or bolt is securely closed when the valve is locked.

LEVER SAFETY VALVES.

All common lever safety valves to be hereafter applied to the boilers of steam vessels shall be constructed in material, workmanship, and principle according to the requirements for a safety valve referred to in this section. When this construction of a safety valve is applied to the boilers of steamers navigating rough waters, the link may be connected direct with the spindle of the valve: *Provided, always*, That the fulcrum or points upon which the lever rests are made of steel, knife, or sharp edged, and hardened; in this case the short end of the lever shall be attached directly to the valve casing. In all cases the link requires but a slight movement not exceeding one-eighth of an inch.

REQUIREMENTS IN CONSTRUCTION OF LEVER SAFETY VALVES.

All the points of bearing on lever shall be in the same plane.

The distance of the fulcrum shall in no case be less than the diameter of the valve opening.

The length of the lever shall not exceed the distance of the fulcrum multiplied by ten.

The width of the bearings of the fulcrum shall be not less than three-fourths of 1 inch.

The length of the fulcrum link shall be not less than 4 inches.

The lever and fulcrum link shall be made of wrought iron or steel and the knife-edged fulcrum points and bearings for the points shall be made of steel and hardened. But the chambers and saddle flanges of this and all other types of safety valves attached to boilers may be made of cast iron or other suitable material.

The valve, valve seat, and bushing for the stem or spindle shall be made of composition (gun metal) when the valve is intended to be attached to a boiler using salt water; but when the valve is to be attached to a boiler using fresh water and generating steam of a high pressure the parts named, with the exception of the bushings for the spindle, may be made of cast iron.

The valve shall be guided by its spindle, both above and below the ground seat and above the lever, through supports either made of composition (gun metal) or bushed with it.

The spindle shall fit loosely in the bearings or supports.

When the valve is intended to be applied to the boilers of steamers navigating rough waters, the fulcrum link may be connected directly with the spindle of the valve; providing always that the knife-edged fulcrum points are made of steel and hardened, and that the vertical movement of the valve is unobstructed by any lateral movement.

In all cases the weight shall be adjusted on the lever to the pressure of steam allowed in each case by a correct steam gauge attached to the boiler. The weight shall then be securely fastened in its position and the lever marked for the purpose of facilitating the replacing of the weight should it be necessary to remove the same, and in no case shall a line or any other device be attached to the lever or weight except in such a manner as will enable the engineer to raise the valve from its seat. (Sec. 4418, R. S.)

WATER-TUBE AND COIL BOILERS.

24. Duplicate blue prints or drawings of water-tube and coil boilers, with their specifications, shall be submitted for approval to the Board of Supervising Inspectors (under sec. 4429, R. S.), and the design approved by said board, before the boilers will be allowed to be used on any vessel coming under the jurisdiction of the Board of Supervising Inspectors. After the approval of the design by the said board, one certified set of the approved blue prints or drawings shall be filed with the records of the Board of Supervising Inspectors, and one certified set with the records of the supervising inspector of each district, and one set of blue prints shall be furnished the office of the local inspectors of the district in which the boiler is manufactured. The blue prints or drawings necessary to comply with the foregoing provisions shall be supplied by the manufacturer. Manu-

facturers shall furnish local inspectors of district where boilers are to be installed an affidavit certifying that the boilers are constructed in accordance with the design and specifications approved by the Board of Supervising Inspectors.

The working pressure allowable on cylindrical shells of water-tube or coil boilers, when such shells have a row or rows of pipes or tubes inserted therein, shall be determined by the following formula:

$$P=\frac{(D-d)\times T\times S}{D\times R}$$

Where P=working pressure allowable in pounds.
D=distance in inches between the tube or pipe centers in a line from head to head.
d=diameter of hole in inches.
T=thickness of plate in inches.
S=one-sixth of the tensile strength of the plate.
R=radius of shell in inches.
n=number of tube holes in a pitch. When tubes on any one row are pitched unequally, nd must be substituted in the formula for d.

Where rows of tubes are pitched diagonally, each diagonal ligament shall be not less than three-fifths of each longitudinal ligament.

Example.

Required the working pressure of a cylindrical shell having holes 1 inch in diameter, spaced 2 inches from center to center, in a line from head to head; material, one-half of an inch thick; diameter of shell, 20 inches; tensile strength of plate, 60,000 pounds.

Substituting values, we have

$$P=\frac{(2-1)\times 0.5\times 10{,}000}{2\times 10}=250 \text{ pounds.}$$

PORCUPINE-TYPE BOILERS.

The formula for determining pressure on boilers of the so-called porcupine and similar types shall be as follows:

Multiply the vertical distance between the centers of the horizontal rows of tubes in inches by one-half the diameter of shell of boiler in inches, which gives the area upon which the pressure is exerted to break a diagonal ligament. then find the sectional area of the ligament at its smallest part and multiply by one-sixth the tensile strength of the material. This result divided by the area upon which the strain is exerted gives the working pressure per square inch, which is as follows: $\frac{E\,F\,T}{C\,D}=W$, the working pressure, in which E equals width of ligament in inches, F thickness of material in inches, T one-sixth of the tensile strength, C distance between vertical centers, and D one-half the inside diameter of the shell or central column.

For the boiler proposed, 30 inches diameter, five-eighths inch thick, tensile strength 60,000 pounds, 1.219 inches would be width of ligament, 0.625 thickness of plate, 10,000 one-sixth of tensile strength, $3\frac{11}{16}$=3.6875 inches, distance of vertical centers; 15 inches, one-half the diameter of shell, would be as follows: 1.219 multiplied by 0.625, this product multiplied by one-sixth the tensile strength, 10,000, equals 7,618.75. This product, divided by the product of 3.6875, distance between vertical centers, multiplied by 15, one-half the diameter, equals 55.3125, gives 137.7 as pressure allowed.

HYDROSTATIC PRESSURE.

All coil and pipe boilers hereafter made, when such boiler is completed and ready for inspection, shall be subjected at the first inspection to a hydrostatic pressure double that of the steam pressure allowed in the certificate of inspection.

The use of malleable-iron or cast-steel manifolds, tees, return bends, or elbows in the construction of pipe generators shall be allowed, and the pressure of steam shall not be restricted to less than one-half the hydrostatic pressure applied to pipe generators unless a weakness should develop under such test as would render it unsafe in the judgment of the inspector making such inspection.

DRUMS AND HEADS.

All drums attached to coil, pipe, sectional, or water-tube boilers not already in use or actually contracted for, to be built for use on a steam vessel, and their building commenced at or before the date of the approval of this rule, shall be required to have the heads of wrought iron or steel or cast steel flanged and substantially riveted to the drums or secured by bolts and nuts of equal strength with rivets, in all cases where the diameters of such drums exceed 6 inches.

Drums and water cylinders constructed with a bumped head at each or either end, any opening in the shell or heads to be reinforced as required by the rules of the board, the circumferential and horizontal seams to be welded and properly annealed after such welding is completed, and when tested with a hydrostatic pressure of at least double the amount of the steam pressure allowed may be used for marine purposes.

COPPER AND BRASS TUBES.

Seamless copper or brass tubes not exceeding three-fourths of an inch in diameter may be used in the construction of water-tube boilers or generators when liquid fuel is used. There may also be used in their construction copper or brass steam drums not exceeding 14 inches in diameter, of a thickness of material not less than five-eighths of an inch, and copper or brass steam drums 12 inches in diameter and under having a thickness of material of not less than one-half inch. All tubes and drums referred to in this paragraph shall be made from ingots or blanks drawn down to size without a seam. Water-tube boilers or generators so constructed may be used for marine purposes with none other than liquid fuel. (Sec. 4429, R. S.)

WELDING AND REINFORCING BY THE ELECTRIC, OXYACETYLENE, OR OTHER PROCESSES.

25. All calking edges on internally fired boilers may be reinforced by these processes.

Calking edges of the shells of externally fired boilers, above the fire line only, may be reinforced.

Cracks extending from edge of lap to rivet, except on seams below the fire line in externally fired boilers, may be welded.

Cracks not exceeding 30 inches in length in back connection sheets, wrapper sheets, bottoms of combustion chambers, heads, and other stayed surfaces may be repaired by welding.

Where cracks are repaired by welding, holes shall be drilled entirely through the plate at each extreme end of the crack, except in small cracks from rivet to calking edge.

Circumferential or lengthwise cracks not exceeding 16 inches in length in plain or corrugated furnaces may be welded.

Where plates in back sheets of back connections, wrapper sheets of sides and bottoms of back connections of any boilers, side sheets and legs of furnaces and bottoms of furnaces of fire-box boilers, and other stayed surfaces are reduced in thickness not exceeding 40 per cent of the original thickness, they may be reinforced, such reinforcing not to exceed an area of 200 square inches in any one plate.

When such reinforcing extends over stays and braces, such stays and braces shall come completely through the reinforcing so as to be plainly visible to the inspectors.

When the corroded portion of stayed or riveted surfaces of the back sheets or wrapper sheets or bottoms of back connections of any boilers, or side sheets and bottom sheets of furnaces or legs of fire-box boiler exceeds 300 square inches, the same may be repaired by the removal of the corroded portion and the replacement thereof by a new piece of plate, the edges of the new plate being welded in position.

Stay bolts, braces, or rivets shall pass through the body of the new plate as before, the area of the new piece not to exceed 24 inches by 24 inches, or 30 inches, in any one direction, the welded edges to be V'd or beveled along the joint prior to welding.

Where plates of shells and other parts of internally fired boilers subject to tensile strain are reduced in thickness by corrosion not to exceed 25 per cent of the original thickness, they may be reinforced, such reinforcing not to exceed an area of 200 square inches.

Where calking edges and laps have been reinforced, local inspectors shall require the rivets to be cut out and redriven if they find by inspection that it is necessary.

Cracks not exceeding 24 inches in length in the shells of internally fired boilers may be repaired by reinforcing the plate to cover the crack with a piece of tested steel plate of not less than one-fourth inch in thickness, said reinforcing plate to be drilled with three-fourths inch holes not more than three inches apart. Such holes in the reinforcing plate shall be countersunk and spot welded through these to the shell of the boiler. The edges of the reinforcing plate shall also be welded to the shell of the boiler. This form of repairs shall only be allowed when made by the electric metallic arc process. Cracks not exceeding 24 inches in length in the shells of externally

fired boilers above the fire line and in mud and steam drums may be reinforced by the above process.

Cracks extending through rivet holes in single-riveted or double-riveted seams in stayed surfaces of back connections of any boilers or side sheets of legs or bottoms of fire-box boilers which are stayed surfaces may be welded up to a length of 6 feet exclusive of rivet holes.

Where cracks extend through rivet holes in stayed surfaces, the piece extending from the rivet to the edge of the lap may be removed where convenient to do so, and the place where the piece has been removed may be replaced by being built up and reinforced by either of these processes.

Where leaks develop around stay bolts and the stay bolts are otherwise intact, the nuts may be removed from the ends of the stay bolts, and the stay bolts may be welded into the shell by welding a beveled collar or ring around the stay bolt. The width and depth of such collar shall equal one-half of the diameter of the stay bolt. In all such cases of applying welding rings or collars around stay bolts, the material shall be hammered while in a glowing state as it is applied.

In all cases where metal is deposited on stayed surfaces, the operator shall hammer, when practicable, the deposited metal while it is in a glowing state.

No repair work by any welding process shall be allowed until coupons showing the character of the work proposed to be done by the applicant have been tested and submitted, together with an explanation and report of the test, to the local inspectors of the district where the work is being done. The local inspectors shall then satisfy themselves whether or not such process can be used with safety on the boilers of steam vessels.

In every case where repairs are to be made by these processes on the boilers of steam vessels subject to the inspection of this service, the parties making the repairs are required to notify the office of the local inspectors, in writing, giving a full detailed description of the repairs to be made, the location of the vessel, and the time the repairs are to be begun, so that inspection may be had, if practicable, prior to and during the time the work is being done.

The application for permission to use this process on boiler repairs of any particular vessel implies a guaranty on the part of the applicant that the work shall, in material, flux, and workmanship, be equal to that of the samples furnished.

Cracks in wrought-iron or wrought-steel headers, and cracks or sand holes in cast-steel, semisteel, ferrosteel, malleable-iron or cast-iron headers, manifolds, crosses, tees, and ells may be repaired by welding cracks or flowing metal into sand holes. Such repaired material other than headers and manifolds shall be subjected to a hydrostatic test of three and one-half times the working pressure after such repairs are made. Reinforcing by building up of any of the above-mentioned articles other than headers shall not be allowed.

When crown-bar bolts have deteriorated or wasted away at top of combustion chamber under the crown bars, such deterioration not to exceed 25 per cent of the original diameter of the bolt, such bolts may be built up or reinforced by any process of autogenous welding.

Where tube sheets of boilers have deteriorated not to exceed 25 per cent of their original thickness, or where cracks have developed in tube sheets, the same may be reinforced and repaired by any process of autogenous welding, and the beading on the ends of tubes may be welded to the tube sheets by the same process. (Secs. 4405, 4418, R. S.)

FEED WATER.

26. Feed water shall not be admitted into any marine boiler at a temperature less than 100° F., and every such boiler, excepting donkey boilers, shall, after October 31, 1909, have an independent auxiliary feed appliance for supplying said boiler with water in addition to the usual mode employed, which auxiliary feed shall enter the boiler through an opening and a fitting which are entirely independent of the fitting and opening for the main feed. (Sec. 4418, R. S.)

MAIN STEAM PIPE.

27. The thickness of and pressure allowed on main steam pipe constructed of riveted iron or steel plates that have been stamped and tested as required by section 4430, Revised Statutes, shall be determined in the same manner as required by section 4433, Revised Statutes, to determine the pressure allowable on boilers.

The thickness of and steam pressure allowable on all lapwelded or solid-drawn steam pipe of wrought iron or steel shall be determined by the following formulas:

$$T=\frac{P\times D}{10{,}000}+0.125$$

$$P=\frac{(T-0.125)\times 10{,}000}{D}$$

Where P=pressure of steam allowable in pounds.
T=thickness of pipe.
D=diameter of pipe.

Example.

Given P=200 pounds pressure. D=5 inches in diameter. Substituting and solving for T,

$$T=\frac{200\times 5}{10{,}000}+0.125=0.225 \text{ inch.}$$

Substituting and solving for P,

$$P=\frac{(0.225-0.125)\times 10{,}000}{5}=200 \text{ pounds.}$$

WELDED STEAM AND WATER PIPES.

From one-eighth of an inch inside diameter up to and including 30 inches inside diameter.

The pipe shall be made of wrought iron or mild steel, smooth, straight, and free from defects.

Threaded pipe of standard thickness shall be avoided as far as possible. In steam pipes it is a very serious matter and shall not be allowed in any case on standard pipe over 5 inches in diameter.

All pipe over 2 inches in diameter shall be lapwelded.

TESTS.

The following tests shall be made before shipment by the manufacturer:

One-eighth inch inside diameter up to and including 3½ inches inside diameter shall be tested before shipment to 600 pounds per square inch hydrostatic pressure and not subject to any other test.

For all diameters greater than 3½ inches inside:

(*a*) *For steel.*—A test piece 2 inches in length cut from a pipe shall stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than one-third the outside diameter of the pipe without showing cracks or flaws, the weld being 45° from the curve.

For iron.—A test ring three times the thickness in length cut circumferentially from lapwelded wrought-iron pipe shall be crushed down to an inner diameter of one-third the outside diameter of the pipe. Wrought-iron pipe will not stand this test without fracture, but no lapwelded wrought-iron pipe shall be accepted where the break is short or crystalline or shows evidence of defective material or bad welding, and in every case the fiber of the iron shall be shown.

(*b*) Pulling tests shall be made from every 50 pieces furnished, or fraction thereof, and shall show the following results:

For Bessemer steel.—Tensile strength not less than 50,000 pounds per square inch. Elongation in 8-inch specimen, not less than 20 per cent.

For open-hearth steel.—Tensile strength not less than 45,000 pounds per square inch. Elongation in 8-inch specimen, not less than 20 per cent.

For iron.—Tensile strength, 40,000 to 48,000 pounds per square inch. Elastic limit, 22,000 to 30,000 pounds. Elongation in 8-inch specimen, not less than 12 per cent.

All pipe from 4-inch diameter up shall be tested before shipment to not less than 500 pounds per square inch hydrostatic pressure.

SEAMLESS STEEL STEAM AND WATER PIPES.

MATERIAL.

The steel shall be made by the open-hearth process.

SURFACE INSPECTION.

Pipe shall be free, inside and outside, from all surface defects that would materially weaken it or form starting points of corrosion. The defects to be especially avoided are snakes, checks, slivers, laps, pits, etc. Pipe shall be smooth and straight.

TESTS.

The following tests shall be made before shipment by the manufacturer:

(*a*) A test piece, 2 inches in length, cut from a pipe, shall stand being flattened by hammering until the sides are brought parallel

with the curve on the inside at the ends not greater than one-third the outside diameter of the pipe, without showing cracks or flaws.

(*b*) Pulling tests shall be made from every 50 pieces furnished, or fraction thereof, and shall show the following results:

Tensile strength, not less than 48,000 pounds per square inch.

Elongation in 8-inch specimen, not less than 12 per cent.

The name or brand of the manufacturer shall be legibly rolled in raised characters or stamped on the outer surface of each pipe.

STATEMENT OR CERTIFICATE OF MANUFACTURER OF STEAM AND WATER PIPES.

When the manufacturers of steam and water pipes file with the Supervising Inspector General a certificate duly sworn to that all such pipes manufactured by them will stand all the tests and meet all the requirements of the foregoing rule, they shall be accepted by inspectors of the service and no other affidavit will be required.

Lapwelded or solid-drawn pipe of wrought iron or steel may be used for mud or steam drums not exceeding 24 inches in diameter for use on boilers when the ends of the pipe have been properly annealed before the holes are drilled or the heads are riveted in.

When pipe is used for steam lines where flanges are riveted on and calked, the ends of the pipe shall be properly annealed before drilling or riveting the flanges on.

FLANGES.

WROUGHT-IRON AND HOMOGENEOUS-STEEL FEED AND STEAM PIPE.

The terminal and intermediate flanges of all wrought-iron and homogeneous-steel feed and steam pipe over 2 inches in diameter, other than on pipe or coil boilers or steam generators, shall be made of wrought iron, homogeneous steel, malleable iron having a tensile strength of not less than 30,000 pounds per square inch of section, or equivalent material.

All such flanges shall have a depth through the bore of not less than one-half of the diameter of the pipe to which the flange is attached.

The bore shall increase slightly toward the face of the flange, and the end of the pipe shall be enlarged to fit the bore of the flange, and shall be substantially beaded over or outward into a recess in the face of the flange.

Flanges on extra heavy lapwelded steam pipe up to and including 5 inches diameter may be attached with screw threads and the joints in bends may be made with extra heavy malleable-iron elbows or equivalent material.

Feed and steam pipe up to and including 3 inches diameter may be connected at intermediate joints by being screwed into flanges or extra heavy fittings.

Flanges of cast iron, semisteel, or ferrosteel, having a tensile strength of not less than 20,000 pounds per square inch of section, may be employed in connecting extra heavy lapwelded pipe by screw threads. Such flanges shall be extra heavy and have a depth through the bore of not less than the United States standard length of thread for the pipe to which the flange is attached plus depth of counter-

bore. The thickness of the flange, excluding hub, shall be not less than three-tenths of the diameter of the pipe plus 0.25 of an inch. The pipe shall fit snugly in the counterbore, which shall be not less than one-fourth the diameter of the pipe in depth.

Flanges of wrought iron or steel grooved in the bore to a depth equal to the thickness of the material in the pipe shall be allowed for use on all steam and feed pipe when the end of the pipe has been thoroughly annealed and expanded into the flange by approved machinery.

Flanges with hubs projecting not less than $1\frac{3}{4}$ inches from the back of the flange may be shrunk on lapwelded or riveted-iron or steel or seamless-drawn steel steam pipes over $5\frac{1}{2}$ inches diameter where the pipe is brought to a true and parallel circle at the end and beaded over into a recess at the face of the flange, or flared to an angle of approximately 20°, or the bore of the flange may be tapered and the pipe expanded into the bore.

Flanges of cast steel, wrought iron, or homogeneous steel, equal in strength to the pipe to which it is attached, may be riveted to the pipe.

Flanges may be secured to pipe by expanding the pipe by proper and approved machinery and flaring the end of the pipe to an angle not exceeding 20°, taken in the direction of the length of the pipe, and having a depth of flare equal to at least one and one-half times the thickness of the pipe.

Flanges of cast steel, forged steel, or wrought iron may be used in any process of expanding the pipe into grooves in the bore of the flange and flaring the end of the pipe to an angle of 20°.

Flanges welded to lapwelded steam pipes of iron or steel may be used when the manufacturer furnishes an affidavit that the pipe has been properly annealed after all work requiring fire has been finished.

All flange connections made by the process of expanding, welding, or shrinking shall be subjected to a hydrostatic test of twice the working pressure without showing signs of weakness.

FLANGES ON COPPER PIPE.

The flanges of all copper steam and feed pipe over 3 inches diameter shall be made of brass or bronze composition, forged-iron or steel or open-hearth steel castings. The end of the pipe shall be flanged over or outward to a width of not less than twice the thickness of the pipe and to a radius of not more than the thickness of the pipe, and the flange securely brazed or riveted to the pipe. If the pipe is properly formed with a fully reinforced taper through the flange the riveting or brazing may be dispensed with. The thickness of flanges shall be not less than four times the required thickness of the pipe plus 0.25 of an inch.

Any form of expanded, grooved, and flared joint will be allowed for copper pipe under the same regulations, restrictions, and tests applying to iron or steel pipe.

All flange joints shall be fitted with such number of bolts or rivets as will make the joint equal in strength to all other parts of the pipe.

Any form of joint which, in the judgment of local inspectors, is equal in strength and efficiency to the flange connections required by this rule shall be allowed on any and all classes of pipe.

COPPER PIPE.

No copper pipe constructed after June 30, 1905, shall have any bend whose radius is less than one and one-half times the diameter of the pipe and such pipe shall be so led and flanges so placed that they may be readily taken down if required. Such pipes shall be protected by iron casings when run through coal bunkers, and shall be clear of the coal chutes. The thickness of material, according to the working pressure, shall be determined by the following formula:

$$T=\frac{P\times D}{8{,}000}+0.0625$$

Where T = thickness in inches.
P = working pressure.
D = inside diameter of pipe in inches.

Example.

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch.

Substituting values, we have

$$T=\frac{175\times 5}{8{,}000}+0.0625=0.171 \text{ inch.}$$

Provided, however, That all copper pipe subject to pressure and installed for use on steam vessels after July 1, 1911, shall have a thickness of material according to the working pressure, to be determined by the following formula:

$$T=\frac{P\times D}{6{,}000}+0.0625$$

Where T = thickness in inches.
P = working pressure.
D = inside diameter of pipe in inches.

Example.

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch.

Substituting and solving, we have

$$T=\frac{175\times 5}{6{,}000}+0.0625=0.208.$$

SLIP JOINTS.

The wearing surface of the male pipe in all slip joints made after June 30, 1908, for use in steam pipes shall be made of copper or composition, and shall be of sufficient length and so adjusted as to prevent accidental withdrawal from the packing box. (Secs. 4405, 4418, R. S.)

CAST STEEL, SEMISTEEL, FERROSTEEL, CAST IRON, MALLEABLE IRON, COMPOSITIONS MADE OF COPPER, TIN, AND ZINC, AND OTHER COMPOSITIONS PROPOSED TO BE USED IN THE MANUFACTURE OF VALVES, FITTINGS, AND OTHER APPLIANCES.

28. Cast-steel fittings of any size or character and for any pressure and for any temperature may be used for any and all steam and feed-pipe connections, and for valves, cocks, and all appliances subject to steam or water pressure when made by regular processes and by manufacturers who stamp such fittings and appliances with their trade-mark or identifying stamp and who guarantee the castings to possess the following physical characteristics: Tensile strength, minimum, 50,000; maximum, 70,000 pounds per square inch; elastic limit, minimum, not less than 45 per cent of tensile strength; elongation in 2 inches, minimum, 25 per cent. There shall be taken from each heat an annealed coupon or coupons, for the purpose of determining the physical tests, and the manufacturers shall furnish coupons to the local inspectors for tests when so required. All steel castings shall be thoroughly annealed.

The minimum thickness of steel fittings shall be determined by the following formula:

$$T=\frac{P\times D}{7{,}000}+0.188$$

Where P=working pressure in pounds.
D=diameter in inches.
T=thickness in inches.

Cast iron, semisteel, or ferrosteel, possessing a tensile strength of not less than 22,000 pounds to the sectional square inch, may be used in the construction of valves and fittings for pressures not exceeding 300 pounds when such valves and fittings of 3 inches diameter or over are stamped with the trade-mark or identifying stamp of the manufacturer, and made in accordance with the following formula:

$$T=\frac{P\times D}{3{,}000}+0.25$$

Where T=thickness of casting in inches.
P=pressure of steam allowable in pounds.
D=internal diameter of the largest opening contained in the cylindrical part of the casting.

The above materials may also be used in the construction of manhole and handhole plates.

The headers of superheaters may be made of semisteel (so-called) in which the constituent part of high-grade uniform steel thereof shall be not less than 25 per cent and that the material shall have a tensile strength of not less than 28,000 pounds per square inch. The material must be soft and close-grained and the castings shall be tight under a hydrostatic pressure of 850 pounds per square inch.

Malleable iron possessing a tensile strength of not less than 30,000 pounds to the sectional square inch may be used in the construction of valves and fittings up to and including 6 inches in diameter, and for pressure not exceeding 300 pounds. Such valves and fittings of 3 inches diameter or over shall be extra heavy, the fittings beaded or banded, and the valves and fittings stamped with the trade-mark or identifying stamp of the manufacturer.

Hard brass, bronze, and other compositions, of which 95 per cent is copper, tin, and zinc, possessing a tensile strength of not less than 30,000 pounds to the square inch, may be used in the construction of all valves and fittings up to and including 12 inches in diameter, and for all pressures not exceeding 300 pounds per square inch.

VALVES.

Each and every valve shall have the trade-mark of the manufacturer cast or stamped on the chamber which shall be understood as a manufacturer's guarantee that the thickness of the walls of the valve chamber is uniform throughout.

Valves of 3 inches diameter and over shall also be stamped with the pressure of steam in pounds which the manufacturer guarantees them to stand without distortion.

Screwed bonnets on cast-iron valves of any size or for any character of service are positively prohibited. All valves over 2 inches in diameter without regard for the service for which they are intended installed after April 30, 1917, shall have bolted bonnets. Valves of 2 inches diameter or less connected directly to the boiler shall be of cast steel, hard brass, or bronze.

On all boilers built after July 1, 1896, a stopcock or valve shall be placed between all check valves and boiler, and between all steam and water pipes and the boiler.

PIPE FITTINGS.

The term "pipe fittings" refers to all hollow cylindrical fittings, and does not apply to flanges or valves.

All pipe fittings of more than 3 inches internal diameter shall be subjected by the manufacturer to a test of three and one-half times the pressure to which they will be subjected in service.

Where the thickness of the material in the boiler or drum, or the heads thereof, is not less than one-half inch, or where such boiler, drum, or head thereof has been reinforced by having a pad or flange riveted on the same, to make the thickness not less than one-half inch, pipes or fittings of 2 inches in diameter or under may be screwed directly into the same. Where steam or feed pipes of 2 inches in diameter or under are screwed into the boiler, the stop valve shall be connected to the boiler by as short a nipple as it is possible to use, nipples to be of extra-heavy thickness.

All boiler connections of over 2 inches in diameter, except the connections for safety valves, shall be permanently flanged and bolted directly to the boiler. Where the connecting point on the boiler is of circular form, distance pieces shall be allowed in order to square

the point of attachment of the flanged fittings, but no such distance piece shall be allowed to exceed 8 inches in length on its shortest side.

Cast-steel flanged fittings, when conforming strictly with the requirements for steel castings, may be used for the purpose of connecting main and auxiliary stop valves and other steam outlets, including safety valves, distance from axis of outlets of such fittings to point of connection with boiler to be as short as practicable.

Valves and fittings of 3 inches and under may be connected by screw threads at their intermediate joints in pipe lines, but at point of connection with boiler all valves and fittings over 2 inches diameter shall be flanged and properly secured by bolts, studs, or rivets, and no fitting shall be of greater length than specified by the "Manufacturers' Standard."

Cast nozzles shall not be used when exposed to the direct action of the fire.

All sea valves or cocks secured to the skin of the vessel by bolts and connected to the engines or boilers by pipes shall be arranged so as to be accessible at all times, so that if a leak or defect occurs it can be reached. All parts of said valves except the chamber shall be made of brass or bronze when used on wooden-hull vessels navigating salt water; but in the case of vessels of iron or steel the brass or bronze bolts may be dispensed with.

ALLOWABLE TEMPERATURES.

Cast iron, malleable iron, semisteel, and ferrosteel may be used in connection with temperatures up to and including 450° F.

Hard brass, bronze, and other compositions, of which 95 per cent is copper, tin, and zinc may be used in connection with temperatures up to and including 470° F., but this temperature may be increased to 550° F. when the manufacturer of the valves or fittings stamps them with the temperature they are guaranteed to stand without disintegration. This paragraph will also apply to any composition meeting the above physical requirements and stamped in accordance therewith.

For all pressures exceeding 300 pounds per square inch or temperatures exceeding 550° F. no valves or fittings other than steel or of a composition whose tensile strength has been demonstrated to exceed 50,000 pounds per sectional square inch with an elongation of 10 per cent in a length of 2 inches shall be allowed. Such valves and fittings shall be stamped as above required.

The manufacturer of valves and fittings shall file with the Supervising Inspector General a certificate duly sworn to that all valves and fittings furnished by him for use on steam vessels comply with the requirements of the foregoing rule.

After July 1, 1911, local inspectors shall refuse to allow the use of any valves or fittings on steam vessels until notified by the Supervising Inspector General that such certificate is on file in his office. This shall not apply to valves and fittings installed previous to July 1, 1911.

EVAPORATORS, FEED-WATER HEATERS, SEPARATORS, AND STEAM TRAPS, MADE OF CAST IRON AND SUBJECT TO BOILER PRESSURE.

When evaporators, feed heaters, separators, and steam traps are constructed of cast iron possessing a tensile strength of not less than 20,000 pounds per square inch, the shells being cylindrical and ends flat or convex, the castings sound and of uniform thickness, the working pressure shall not exceed that found by the following formulas:

Flat surface:

$$P=\frac{20{,}000\times T^2}{D^2}$$

$$T=\sqrt{\frac{P\times D^2}{20{,}000}}$$

Cylindrical shell:

$$P=\frac{3{,}500\times T}{D}$$

$$T=\frac{P\times D}{3{,}500}$$

Where P=working pressure per square inch in pounds.
T=thickness in inches.

Provided, 1. That the thickness of ends of evaporators, feed heaters, and separators shall be not less than three-eighths of an inch. 2. That to the resultant thickness obtained by the formula given above there shall be added, for cylinders having an inside diameter of 1 inch to 6 inches, inclusive, one-fourth of an inch; for cylinders having an inside diameter of over 6 inches to 15 inches, inclusive, one-eighth of an inch.

D=diameter inside in inches. When the pressure is to be determined for a part of a flat surface which is a square, or rectangle in the flat surface formula, the value of D used shall be the diagonal of the square or rectangle, and when the ends are bolted to the shell the value of D used shall equal the diameter of the bolt circle.

All flanges shall be substantial, and there shall be a good fillet all around the root, and when the ends and shell are cast solid there shall be a good and substantial fillet inside all around.

The bolts or studs for the ends or doors shall not have a greater stress than 6,000 pounds per square inch, and the size of bolts or studs shall be not less than three-fourths of an inch in diameter.

EVAPORATORS.

Evaporators shall be provided with an efficient safety valve of approved type, set to blow at the maximum pressure to which the evaporator will be subjected in service, and it shall be the duty of the engineer in charge of the vessel to see that such valve blows off at least once in 30 days. (Sec. 4418, R. S.)

Rule III.—Boats, Rafts, Bulkheads, and Life-Saving Appliances.

GREAT LAKES STEAMERS.

1. Under this designation shall be included all steam vessels navigating the Great Lakes.

CLASSES OF VESSELS.

2. For the purpose of apportioning lifeboat and life-raft equipment upon Great Lakes steam vessels subject to the jurisdiction of the Steamboat-Inspection Service they shall be divided into the following classes:

(*a*) Passenger steam vessels navigating more than 3 miles offshore.

(*b*) Passenger steam vessels navigating not more than 3 miles offshore.

(*c*) Passenger steam vessels navigating routes where the water is not of a depth on any part of the route to submerge the upper deck of the vessel.

(*d*) Passenger steam vessels the keels of which are laid after July 1, 1915, for service on routes more than 3 miles offshore.

(*e*) Cargo steam vessels.

(*f*) All steam vessels not otherwise provided for.

LIFEBOATS AND LIFE RAFTS REQUIRED.

LIFEBOATS AND LIFE RAFTS REQUIRED ON VESSELS OF CLASS (*a*).

3. *Vessels of class* (*a*) shall be required to have lifeboat and life-raft capacity to accommodate all persons on board. Not less than 75 per cent of the total capacity shall be in lifeboats and 25 per cent may be in collapsible lifeboats or life rafts of an approved type. Vessels of this class navigating during the interval between May 15 and September 15 in any one year, both dates inclusive, shall be required to be equipped with only such lifeboats and life rafts as will accommodate 50 per cent of all persons on board, of which accommodation not less than two-fifths shall be in lifeboats and three-fifths may be in collapsible lifeboats or life rafts of an approved type.

LIFEBOATS AND LIFE RAFTS REQUIRED ON VESSELS OF CLASS (*b*).

4. *Vessels of class* (*b*) shall be required to have lifeboat and life-raft capacity to accommodate all persons on board. Not less than 25 per cent of the total capacity shall be in lifeboats and 75 per cent may be in collapsible lifeboats or life rafts of an approved type. Vessels of this class navigating during the interval between May 15 and September 15 in any one year, both dates inclusive, shall be required to be equipped with only such lifeboats and life rafts as will accommodate 10 per cent of all persons on board, of which accommodation not less than 25 per cent shall be in lifeboats and 75 per cent may be in collapsible lifeboats or life rafts of an approved type.

LIFEBOATS AND LIFE RAFTS REQUIRED ON VESSELS OF CLASS (*c*).

5. *Vessels of class* (*c*) shall be required to have lifeboat and life-raft capacity to accommodate all persons on board. Not less than 25 per cent of the total capacity shall be in lifeboats and 75 per cent may be in collapsible lifeboats or life rafts of an approved type. Vessels of this class navigating during the interval between May 15

and September 15 in any one year, both dates inclusive, shall be required to be equipped with only such lifeboats and life rafts as will accommodate 10 per cent of all persons on board, of which accommodation not less than 25 per cent shall be in lifeboats and 75 per cent may be in collapsible lifeboats or life rafts of an approved type.

LIFEBOATS AND LIFE RAFTS REQUIRED ON VESSELS OF CLASS (*d*).

6. *Vessels of class* (*d*) shall be required to have lifeboat and life-raft capacity to accommodate all persons on board. Not less than 75 per cent of the total capacity shall be in lifeboats and 25 per cent may be in collapsible lifeboats or life rafts of an approved type. Vessels of this class navigating during the interval between May 15 and September 15 in any one year, both dates inclusive, shall be required to be equipped with only such lifeboats and life rafts as will accommodate 50 per cent of all persons on board, of which accommodation not less than two-fifths shall be in lifeboats, and three-fifths may be in collapsible lifeboats or life rafts.

LIFEBOAT CAPACITY REQUIRED OF VESSELS OF CLASS (*e*).

7. *Vessels of class* (*e*) shall be required to have lifeboat capacity to accommodate all persons on board.

LIFEBOATS AND LIFE RAFTS REQUIRED ON VESSELS OF CLASS (*f*).

8. *Vessels of class* (*f*).—*Steam vessels of 50 gross tons and over not carrying passengers* shall be required to have lifeboat and life-raft capacity to accommodate all persons on board, of which accommodation not less than 50 per cent shall be in lifeboats and 50 per cent may be in collapsible lifeboats or life rafts of an approved type.

Steam vessels of less than 50 gross tons not carrying passengers shall be required to have lifeboat or life-raft capacity to accommodate all persons on board.

Steamers of less than 150 gross tons, while engaged exclusively in *harbor towing*, may substitute one or more life rafts for the lifeboats required, when the lifeboats interfere with the practical operation of the steamer and such substitution may be made with safety, it being understood that when such vessel engages in service other than harbor towing she shall be equipped with lifeboats as required by the rules.

Pleasure steam vessels navigating more than 3 miles offshore shall have the same lifeboat and life-raft capacity as vessels of class (*a*).

Pleasure steam vessels navigating not more than 3 miles offshore shall have the same lifeboat and life-raft capacity as vessels of class (*b*).

Steamers that are used exclusively as *fire boats* and connected or belonging to a regularly organized fire department shall be required to carry only such boats or rafts as in the judgment of the local inspectors or supervising inspector may be necessary to carry the crew.

Lifeboats and other equipment required on *ferryboats* are prescribed in Rule VII; and on *towed passenger barges*, in Rule IX. (Secs. 4426, 4492, R. S.)

WOODEN SURFBOAT OR SEINE BOAT.

9. Vessels engaged exclusively in the business of seine fishing or wrecking may substitute a wooden seine boat or a wooden surfboat for the lifeboat required on vessels of class (*f*).

LIFEBOATS AND RAFTS REQUIRED ON INSPECTED MOTOR VESSELS.

10. All vessels propelled by machinery, other than steam, subject to the inspection laws of the United States shall be required to have the same lifeboat and life-raft equipment as steam vessels of the same class, and local inspectors shall so indicate in the certificate of inspection. This paragraph shall not apply to such vessels under 50 tons, when navigating in daylight only, and when equipped with air tanks under deck of sufficient capacity to sustain afloat the vessel when full of water, with her full complement of passengers and crew on board, or when properly subdivided by iron or steel water-tight bulkheads of sufficient strength and so arranged and located that the vessel will remain afloat with her complement of passengers and crew on board with any two compartments open to the sea.

WORKING BOAT.

11. Steamers of 200 gross tons and upward carrying passengers shall have one working boat with life lines attached, properly supplied with oars and painter, and kept in good condition at all times and ready for immediate use, in addition to the lifeboats required.

MOTOR-PROPELLED LIFEBOATS ON VESSELS.

12. Any vessel under the jurisdiction of this service may be allowed to carry one motor-propelled lifeboat as a part of the lifeboat equipment required on such vessel, except that on vessels carrying more than six lifeboats under davits two of such lifeboats may be equipped with motors.

Gasoline may be used for such motors when it is carried only in substantial seamless steel, welded steel, or copper tanks securely and firmly fitted in such lifeboats and located where the greatest safety will be secured.

All fittings, pipes, and connections shall be of the highest standard and best workmanship and in accordance with the best modern practice. Storage of gasoline other than in the lifeboats using it shall not be allowed under any circumstances.

In computing the cubic capacity of motor-propelled lifeboats the space required for the engine. boiler, motor, and fuel shall be excluded. (Sec. 4472, R. S.)

EQUIPMENT FOR LIFEBOATS.

13. All lifeboats on vessels of classes (*a*), (*b*), (*c*), (*d*), and (*e*) shall be equipped as follows:

A properly secured life line the entire length on each side, festooned in bights not longer than 3 feet, with a seine float in each bight. The life line shall be of a size and strength not less than

12-thread manila rope, and the seine float in each bight shall hang to within 12 inches of the surface of the water when the boat is light.

One painter of manila rope of not less than $2\frac{3}{4}$ inches in circumference and of suitable length.

A full complement of oars and two spare oars.

One set and a half of thole pins or rowlocks attached to the boat with separate chains.

One steering oar with rowlock or becket and one rudder with tiller or yoke and yoke lines.

One boat hook attached to a staff of suitable length.

Two life preservers.

Two hatchets.

One galvanized-iron bucket with lanyard attached.

One bailer.

Where automatic plugs are not provided there shall be two plugs secured with chains for each drain hole.

One efficient liquid compass with not less than a 2-inch card.

One lantern containing sufficient oil to burn at least nine hours and ready for immediate use.

One can containing one gallon of illuminating oil.

One box of friction matches wrapped in a waterproof package and carried in a box secured to the underside of the stern thwart.

A water-tight metal case containing 12 self-igniting red lights capable of burning at least two minutes.

A sea anchor.

A vessel containing 1 gallon of vegetable or animal oil, so constructed that the oil can be easily distributed on the water and so arranged that it can be attached to the sea anchor.

All loose equipment must be securely attached to the boat to which it belongs.

Lifeboats of class (*f*) shall be equipped with a properly secured life line the entire length on each side, such life line to be festooned in bights not longer than 3 feet, with a seine float in each bight; at least two life preservers, or two wooden floats where the same are allowed by law; one painter of manila rope of not less than $2\frac{3}{4}$ inches in circumference, properly attached, and of suitable length; a full complement of oars and two spare oars of suitable length; a full complement of rowlocks and two spare rowlocks, each rowlock to be attached to the boat with a separate chain; one steering oar with rowlock or becket, or one rudder with yoke and suitable yoke ropes; one boat hook attached to staff of suitable length, one ax, one bucket with lanyard attached. Wooden boats shall have, in addition to the above, two plugs for each drain hole, attached to the boat with chains. (Sec. 4488, R. S.)

HOW LIFEBOATS MUST BE CARRIED AND DAVITS AND CRANES REQUIRED.

14. All lifeboats on vessels carrying passengers shall, if practicable, be carried under substantial davits or cranes, but if it is not practicable so to carry all the lifeboats required, the remainder shall be stowed near at hand, so as to be easily and readily launched. Such davits, cranes, and necessary gear shall be such as will enable the lifeboats to be lowered to the water in less than two minutes from the time the clearing away of the boats is begun.

Each lifeboat carried under davits shall be provided with two separate davits. When a single crane is properly adapted to lower a lifeboat, it may be allowed to take the place of the two davits. Such davits or cranes, and the blocks and falls thereof, on all passenger vessels except ferryboats, shall be of sufficient strength to carry the boat with its full load.

On and after May 1, 1920, the complete installation of all mechanical boat davits shall be tested and demonstrated for strength and efficiency at the place of manufacture in the presence of an inspector of the Steamboat-Inspection Service.

The frame, gear, worms, arms, and all machinery in connection with the operation of the device shall be set up in the shop in the same manner as when installed for use on board the ship and shall be tested in the following manner: A weight equal to the weight of the boat with its equipment and complement of persons that the davit is intended to serve, the weight of the persons being considered as 140 pounds each, shall be suspended from the eye or end of the davit arm, and while the weight is in suspension, the davit arm shall be operated from the inboard position to the full outboard position, with the same operating crank or device that is used in actual practice on board the ship. Under this test the davit arm shall show no permanent set or deflection, and the frame, gear, and operating mechanism shall show no distress or distortion. After this test is concluded, the davit arm, if of cast material, shall undergo a percussion test by being dropped from a height of not less than 8 feet to a hard unyielding base, and then slung up and subjected to a test by being well hammered with a sledge hammer not less than 7 pounds in weight, to satisfy the inspector that the casting is sound and without flaw.

When steel castings are employed for frames or davit arms the castings shall be thoroughly annealed and the tensile strength of the castings shall be not less than 58,000 pounds nor more than 78,000 pounds per square inch, with an elongation of not less than 20 per cent measured on the test piece used in determining the tensile stress. Sample pieces must be a part of the annealed casting and must represent the casting after it has been thoroughly annealed, and if the casting has afterwards been heated for any purpose it shall be again annealed. The manufacturer shall furnish the inspector, when required, an affidavit setting forth the fact that the required tests respecting annealing and the requirements for tensile stress and ductility have been fully complied with.

When the assembled installation meets the foregoing requirements and the inspector is satisfied that the device is efficient in strength and operation, he shall stamp the davit arm and the frame to which it is attached, which shall bear identical numbers of the manufacturer, with the letters "U. S. I.," the initials of his name, and a serial number. No davit arm or frame comprising mechanical davits shall be placed on board any vessel until all these requirements have been fully complied with.

DRAWINGS, SPECIFICATIONS, NAME PLATE.

15. All *lifeboats* shall be substantially constructed in accordance with drawings, or blue prints, and specifications approved by the supervising inspector of the district in which the lifeboats are built.

Builders of lifeboats shall furnish the supervising inspector of the district in which the lifeboats are built drawings, or blue prints, and specifications showing and explaining the construction of same, and showing the tensile strength and ductility of the metal used. The metal used shall have a tensile strength of not less than 40,000 pounds per square inch, and an elongation in a length of 4 inches of at least 20 per cent when the thickness of the metal is of, or greater than, No. 16 B. W. G., and 15 per cent when the thickness of the metal is less than No. 16 B. W. G.

Builders of lifeboats shall affix a plate or other device to each lifeboat, having thereon the builder's name, number of boat, date of construction of boat, cubical contents of boat, and number of persons said boat will carry, as determined by the rules of the Board of Supervising Inspectors.

INSPECTION OF LIFEBOATS WHEN BUILT.

16. Supervising inspectors of districts where lifeboats are built shall detail an assistant or local inspector to any place where lifeboats are being built, whose duty it shall be to carefully inspect and examine the construction of such lifeboats, and he shall satisfy himself that such lifeboats are constructed in accordance with the drawings, or blue prints, and specifications furnished by the builders. When the assistant or local inspector approves the construction of the boat he shall stamp his initials, together with the letters "U. S. I.," on a blank space on the plate required to be affixed to the boat by the builder. The initials of the assistant or local inspector shall be satisfactory evidence to all parties interested that the boat has been constructed in accordance with the drawings, or blue prints, and specifications on file.

BOATS OF THE FIRST CLASS.

CONSTRUCTION OF METALLIC LIFEBOATS OF CLASS 1A.

17. All metallic lifeboats shall be constructed in accordance with following specifications:

The keels, stems, sternposts, gunwales, and nosings shall be of clear-grain, sound oak or other suitable wood, each in one length, except that the gunwales and nosings may be made in two lengths. When made in two lengths the gunwales shall be scarfed with a good long bevel scarf stiffened on the underside by a piece of gunwale material at least 2 feet in length, $1\frac{1}{2}$ inches thick, and the width of the gunwale.

The *stem* of each boat shall be of a natural or steam crook, scarfed at least 9 inches in length on the keel and fastened thereto with two $\frac{3}{8}$-inch through clinch bolts driven through deadwood fitted on the inside.

Each *sternpost* shall be stepped over the end of the keel half the length of the sternpost and recessed at least $2\frac{1}{2}$ inches deep into keel, the whole to be secured on the inside by a crook or knee of sufficient width to receive the flanges of the shell plates.

Each joint of the stem and sternpost shall be fitted with two $\frac{3}{8}$-inch *stopwaters* under the shell flanges. Stem and sternpost shall be bearded to not less than $1\frac{1}{2}$ inches.

The *flanges of shell plates* on boats not over 20 feet long shall lap on the keel, stem, and sternpost at least $2\frac{1}{4}$ inches; on boats over 20 feet and not over 24 feet long, at least $2\frac{1}{2}$ inches; and on boats over 24 feet long, at least $2\frac{3}{4}$ inches, to be fairly drawn up and nailed over a strip of No. 6 cotton duck the width of the flanges, which shall be secured by three rows of galvanized nails driven zigzag. No part of the keel, stem, or sternpost outside of the shell flanges shall be covered with sheet metal.

In boats not over 20 feet long the *nails* shall be driven zigag on lines $\frac{3}{8}$, $1\frac{1}{8}$, and $1\frac{5}{8}$ inches, respectively, from the edge of the flanges and pitched $1\frac{3}{4}$ inches. In boats over 20 feet and not over 24 feet long the nails shall be driven on lines $\frac{3}{8}$, $1\frac{1}{4}$, and $2\frac{1}{8}$ inches, respectively, from the edge of the flanges and pitched $1\frac{5}{8}$ inches. In boats over 24 feet long the nails shall be driven on lines $\frac{3}{8}$, $1\frac{3}{8}$, and $2\frac{3}{8}$ inches, respectively, from the edge of the flanges, and pitched $1\frac{1}{2}$ inches.

In boats not over 20 feet long the nails shall be not less than $1\frac{3}{4}$ inches long, No. 10 B. W. G. In boats over 20 feet and not over 24 feet long the nails shall be not less than 2 inches long, No. 10 B. W. G. In boats over 24 feet long the nails shall be not less than $2\frac{1}{2}$ inches long, No. 9 B. W. G.

Metallic lifeboats of a length not over 20 feet shall be constructed of *plates* of not less thickness than No. 18 B. W. G. Boats over 20 feet and not over 24 feet long shall be constructed of plates of not less thickness than No. 16 B. W. G. Boats longer than 24 feet shall be constructed of plates of not less thickness than No. 14 B. W. G.

All *seams and joints* shall be properly double riveted. The seams and butt laps shall lap at least $1\frac{1}{4}$ inches.

The center of the row of *rivets* nearest the edge of a sheet shall be about three-eighths of an inch from the edge. Rivets shall be staggered with not less than 18 rivets to the foot, and shall have countersunk heads. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

The keels, stems, and sternposts shall be not less than the following sizes:

Length of boat.	Width of keel, stem, and stern-post.	Depth of keel, stem- and stern, post.
	Inches.	*Inches.*
Not over 18 feet	1.8	4.2
Over 18 and not over 20 feet	2.0	5.0
Over 20 and not over 21 feet	2.1	5.0
Over 21 and not over 22 feet	2.2	5.0
Over 22 and not over 23 feet	2.3	5.0
Over 23 and not over 24 feet	2.4	5.0
Over 24 and not over 25 feet	2.5	5.0
Over 25 and not over 26 feet	2.6	5.0
Over 26 and not over 27 feet	2.7	5.0
Over 27 and not over 28 feet	2.8	5.0

The keels of all boats over 26 feet long shall be strengthened by the addition of a main *keelson* extending not less than two-thirds the

length of the boat and having one-half the area of the main keel, to which it shall be through fastened with $\frac{3}{8}$-inch clinch bolts spaced not more than 14 inches.

Steel having one-sixth the sectional area of wood found by the above table may be used in lieu of wood for keels, stems, and sternposts of metallic lifeboats.

All steel keels, stems, and sternposts shall be painted with two coats of red lead and oil.

The shell plates shall be riveted to the steel keels, stems, and sternposts with button-head rivets of not less than $\frac{3}{16}$ inch in diameter for boats less than 24 feet in length, not less than $\frac{1}{4}$ inch in diameter for boats of 24 feet up to and including 27 feet in length, and not less than $\frac{5}{16}$ inch in diameter for boats from 28 feet up to and including 30 feet in length.

The rivets shall be staggered not less than 12 rivets to the foot.

The shell plating attached to the steel keels, stems, and sternsposts shall be laid over flannel or felt and red lead to insure watertightness. Any form of joint insuring the same result may be approved by the supervising inspector of the district in which the lifeboat is built.

The size of gunwales shall be of not less than the following dimensions:

Length of boat.	Depth of gunwale.	Width of gunwale.
	Inches.	*Inches.*
Not over 18 feet	$1\frac{1}{4}$	2
Over 18 and not over 20 feet	$1\frac{5}{8}$	$2\frac{1}{8}$
Over 20 and not over 22 feet	2	$2\frac{1}{4}$
Over 22 and not over 24 feet	$2\frac{1}{8}$	$2\frac{3}{8}$
Over 24 and not over 26 feet	$2\frac{1}{4}$	$2\frac{1}{2}$
Over 26 and not over 28 feet	$2\frac{3}{8}$	$2\frac{5}{8}$

The gunwales of boats not over 22 feet long shall be attached to the thwarts by steel *braces* at least $1\frac{1}{4}$ inches wide by five-sixteenths of an inch thick, teed 4 inches on the thwarts and secured thereto by two $\frac{1}{4}$-inch carriage bolts, and to the gunwales by a $\frac{1}{4}$-inch bolt clinched over the plate on the outside. In boats over 22 feet long such steel braces shall be at least $1\frac{1}{2}$ inches by three-eighths of an inch, teed 5 inches on the thwarts and secured thereto by three $\frac{1}{4}$-inch carriage bolts, and to the gunwales by $\frac{5}{16}$-inch bolts clinched over the plate on the outside. All sheer plates shall come up on the gunwale to within one-half inch of its top and be nailed thereto with $1\frac{1}{2}$-inch boat nails spaced 6 inches.

All *nosings* shall be formed of so-called half rounds, mitered to fit fairly against the gunwales and sheer plates, through which they shall be nailed to the gunwales every 6 inches with wire nails of No. 10 gauge and not less than $2\frac{3}{4}$ inches long. The flat side of nosings on boats of not over 20 feet long shall be not less than $1\frac{3}{8}$ inches wide and five-eighths of an inch thick. On boats over 20 feet and not over 24 feet long the flat side of the nosing shall be not less than $1\frac{7}{8}$ inches wide and 1 inch thick through the round. On all boats over 24 feet long the flat side of the nosing shall be not less than $2\frac{1}{4}$ inches wide and 1 inch thick through the round.

All *thwarts* shall be made of clear yellow pine or fir.

In boats not over 20 feet long thwarts shall be at least $1\frac{1}{8}$ inches thick by $7\frac{1}{2}$ inches wide. In boats over 20 feet and not over 24 feet long they shall be at least $1\frac{1}{4}$ inches thick by 8 inches wide. In boats over 24 feet long they shall be $1\frac{3}{8}$ inches thick by 9 inches wide. All thwarts over $4\frac{1}{2}$ feet long shall be supported by *stanchions* of pine of 1 inch by 5 inches. Every thwart shall be secured at each end to the boat by a double or U flange of No. 16 plate riveted to the shell with five rivets. The thwarts shall be pushed in between those flanges and secured thereto by five boat nails driven down through the upper flanges, thwarts, and lower flanges, and turned over beneath.

Breasthooks formed of steel for boats not over 20 feet long shall be one-fourth inch thick and $1\frac{1}{4}$ inches wide. In boats over 20 feet and not over 24 feet long such hooks shall be five-sixteenths of an inch thick by $1\frac{3}{8}$ inches wide. In boats over 24 feet long such hooks shall be five-sixteenths of an inch thick by $1\frac{1}{2}$ inches wide.

No breasthooks shall be less than 9 inches long.

Breasthooks shall be fastened through the gunwales each side with three one-fourth-inch button-head bolts clinched over the shell plate. All such breasthooks shall be upset in the throat sufficient to allow the upper bolt through the ring strap to pass through the hook without reducing the sectional area thereof.

The *midship footings* in boats not over 18 feet long shall be not less than seven-eighths of an inch thick and have two footings on each side, which footings shall be seven-eighths of an inch thick by 7 and 5 inches wide, respectively. The midship footings in boats over 18 feet and not over 24 feet long shall be not less than 1 inch thick by 12 inches wide and have three footings on each side, which shall be 1 inch thick by 7, 6, and 4 inches, respectively, in width. The midship footings in boats over 24 feet and not over 26 feet long shall be not less than 1 inch thick and 12 inches wide, and such boats shall have not less than three footings on each side, each to be not less than 1 inch thick by 7, 6, and $4\frac{1}{2}$ inches, respectively, in width. Boats over 26 feet long having a keelson shall have three footings on each side 1 inch thick by 8, 6, and 5 inches, respectively, in width. All said footings shall be fitted fairly to the bottom over a coat of lead paint and held in place by straps of No. 18 plate, $1\frac{1}{8}$ inches wide, riveted with four rivets to the boat shell. The strap shall pass up through an aperture in the middle of each footing and receive a toggle of gas pipe five-eighths of an inch in diameter and of a length not less than two-thirds of the width of the footing. There shall be not less than four such toggles in each footing in boats not over 20 feet long, nor less than five such toggles in boats over 20 feet and not over 24 feet long. In boats over 24 feet long there shall be six such toggles in each footing. The midship footings shall be secured to the bottom by straps and toggles in two rows placed 3 inches from each edge of the footing, and fastened with toggles of one-half-inch pipe $3\frac{1}{2}$ inches long. Hardwood toggles may be used in lieu of pipe when the same are formed of oak of so-called half rounds, 1 inch on their flat side and three-fourths of an inch thick. Iron or steel of so-called half round not less than five-eighths of an inch on the flat side and not less than three-sixteenths of an inch thick may also be used for toggles.

The *tackle rings* in boats not over 18 feet long shall be formed of not less than $\frac{5}{8}$-inch round steel. In boats over 18 feet and not over

22 feet long such rings shall be formed of not less than $\frac{3}{4}$-inch round steel. In boats over 22 feet and not over 26 feet long such rings shall be formed of not less than $\frac{13}{16}$-inch round steel. In boats over 26 feet long such rings shall be formed of not less than $\frac{7}{8}$-inch round steel. Such rings shall be welded through eyes of equal strength in the ring straps, which straps shall have a sectional area on each side of the upper bolt hole equal to that of the ring, and the sectional area of strap on each side of the next bolt hole shall be two-thirds that of such ring, and on each side of the next row of bolt holes one-half that of such ring. *Hooks* may be allowed in lieu of rings when constructed of equal strength to rings and attached to the boat as securely as the rule provides for rings.

Each and every lifeboat shall be fitted with a painter ring properly secured, of a size and strength not less than that specified for tackle rings.

The pitch of bolt holes in all such straps shall be 3 inches.

In boats not over 18 feet long said ring straps shall be secured with three bolts $\frac{1}{2}$ inch in diameter. In boats over 18 feet and not over 22 feet in length such ring straps shall be secured by three bolts $\frac{5}{8}$ inch in diameter. In boats over 22 feet and not over 26 feet long such ring straps shall be secured by four bolts $\frac{5}{8}$ inch in diameter. In boats over 26 feet long such ring straps shall be secured by five bolts, the upper two of which shall be $\frac{5}{8}$ inch in diameter and the other three $\frac{9}{16}$ inch in diameter. The two upper bolts shall be driven through and clinched on the outer edge of the stem and sternpost. The lower bolt or bolts may be driven blunt $3\frac{1}{2}$ inches into the stem and sternpost. The upper bolts shall pass through the breasthooks.

All boats shall be fitted with *rudders* made of clear, straight-grained oak or fir, which shall be stiffened across the bottom edge by a piece of wood of the same character, properly nailed.

All gudgeons and pintles shall be strapped to the wood and through fastened.

Each lifeboat shall be fitted with an *automatic plug*.

All the shell plates, air tanks, nails, gunwale braces, rudder braces, and fastenings of metallic boats shall be *galvanized* when said parts are made of steel or iron.

The *gauge numbers* referred to in Rule III are the Birmingham standard (B. W. G.)

CONSTRUCTION OF WOODEN LIFEBOATS.

18. Wooden lifeboats shall be substantially constructed and in every way equal in strength and stability to a metallic boat built in accordance with the above specifications.

AIR TANKS OF LIFEBOATS.

19. All lifeboats constructed after June 30, 1905, shall be provided with air tanks, and in all lifeboats of 18 feet in length or over, for lake, bay, or sound steamers contracted for after September 30, 1912, not more than 50 per cent of the air-tank capacity shall be allowed in the ends of the boat, and the remaining capacity shall be located in the side tanks: *Provided, however*, That wooden lifeboats for use on steam pleasure vessels shall be exempt from the use of air tanks.

After June 20, 1912, the air tanks of all lifeboats shall be entirely independent of the hull or other construction and shall be of suitable

noncorrosive material and of a capacity of not less than 1.5 cubic feet for each person allowed in metallic boats and not less than 1 cubic foot for each person allowed in wooden boats. Such air tanks shall be firmly and securely fastened in the hull, and in such manner as will allow them to be temporarily removed, and in no case shall the tanks be punctured or opened for such fastenings. The tops of such tanks shall be thoroughly protected by a grating or platform or by the thwarts or seats. Such air tanks of 6 cubic feet or less shall be constructed of material of a thickness not less than No. 22 B. W. G.; from 6 cubic feet to and including 15 cubic feet, of a thickness not less than No. 20 B. W. G.; and all air tanks of more than 15 cubic feet capacity shall be of a thickness not less than No. 18 B. W. G.

All joints of air tanks shall be properly double riveted and tightly calked or securely hook jointed and efficiently soldered or properly and securely welded, and such air tanks shall be located in such a manner that will permit the lifeboat to be on as near an even keel as possible when flooded with water.

The cubic contents of air space of air tank shall be stamped on the tank where same can be seen when air tank is placed in boat.

All air tanks shall be fitted with a connection of one-half inch outside diameter for testing purposes.

Before any lifeboat is passed and accepted, the air tanks thereof shall be tested in the presence of an inspector of this service by an air pressure of not more than 1 pound to the square inch. At each subsequent annual inspection, or oftener if in the opinion of the inspectors it is necessary or desirable, the inspectors shall satisfy themselves that the tanks are in good condition, but pressure need not be applied unless the inspectors are in doubt regarding the efficiency of the tanks. This does not take from the inspectors the right and authority to satisfy themselves at any time, either by examination or pressure, as to the condition of the tanks. (Secs. 4405, 4488, R. S.)

CARRYING CAPACITY OF LIFEBOATS.

20. The capacity of all lifeboats not otherwise provided for shall be determined by the following rule: Measure the length and breadth outside of the planking or plating and the depth inside at the place of minimum depth. The product of these dimensions multiplied by 0.6 resulting in the nearest whole number shall be deemed the capacity in cubic feet.

To determine the number of persons a boat is to carry, divide the result by 10.

Example.

The carrying capacity of a boat 22 feet in length, 6 feet in breadth, and $2\frac{1}{2}$ feet in depth shall be determined as follows:

$$\frac{22\times6\times2\frac{1}{2}\times0.6}{10}=\frac{198}{10}=19 \text{ persons.}$$

Every lifeboat shall have sufficient room, freeboard, and stability to safely carry the number of persons allowed to be carried by the above rule, which fact shall be determined by actual test in the water at the time of the first inspection of the lifeboat, except that where a vessel is carrying lifeboats of different types or capacities, at least one lifeboat of each type or capacity shall be so tested.

MARKING OF LIFEBOATS.

21. All lifeboats shall have the number of boat plainly marked or painted on each bow, in figures not less than 3 inches high. Where lifeboats are carried on both sides of a vessel, lifeboat No. 1 shall be forward on the starboard side of vessel, lifeboat No. 2 forward on port side, lifeboat No. 3 next abaft lifeboat No. 1 on starboard side, lifeboat No. 4 next abaft lifeboat No. 2 on port side; and so forth, the odd-numbered boats being on the starboard side and the even-numbered boats being on the port side of vessel. All lifeboats shall have their cubic contents and the number of persons such lifeboat is allowed to carry plainly marked or painted on each bow in letters and figures not less than three-fourths of an inch high. All lifeboats shall also have the number of persons allowed to be carried plainly marked or painted on top of at least two of the thwarts, in letters and figures not less than 3 inches high. When the letters and figures above required are painted on lifeboats, such letters and figures shall be dark on a light ground or light on a dark ground.

LIFE BOATS AND LIFE RAFTS KEPT CLEAR FOR LAUNCHING.

22. The decks on which lifeboats of any class or life rafts are carried shall be kept clear of freight or any other obstruction that would interfere with the immediate launching of the lifeboats or life rafts. (Secs. 4405, 4488, R. S.)

BOAT-DAVIT FALLS AND RECEPTACLES THEREFOR.

23. It shall be the duty of the master or officer in charge of all vessels to see that the boat-davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat-davit falls on all boats not swung out at boat drills shall be cast loose and overhauled; and it shall be unlawful to stow in any lifeboat articles other than those required by law and regulations. On all steamers over 1,000 gross tons, covered tubs, boxes, or reels shall be provided in which to stow away the boat-davit falls.

CARE OF LIFEBOATS.

24. Lifeboats shall be stripped, cleaned, painted, and thoroughly overhauled at least once in every year.

STRENGH AND TEST OF BOATS.

25. Each boat shall be of sufficient strength to enable it to be safely lowered into the water when loaded with its full complement of persons and equipment.

At every annual inspection of a passenger vessel every lifeboat shall be tested by lowering to the water, or when it can not be lowered to the water, to a wharf, and loaded to its allowed capacity, evenly distributed throughout its length. The boat shall then be lifted clear of the water or wharf to determine that the boat and falls are of sufficient strength. In making the above test of lifeboats, the weight of each person shall average at least 140 pounds. When deadweight is used, the weight shall be equivalent to at least 140 pounds for each person allowed.

BRUDE LIFEBOAT.

26. Lifeboats of the Brude type, of the sizes specified below, for use on cargo steamers, shall be allowed the following rating:

Length.	Height.	Width.	Number of persons carried and allowed on cargo steamers.
Feet.	*Ft. in.*	*Ft. in.*	
18	8 0	8 0	34
14	6 9	6 9	17

The number of persons allowed to be carried by boats of this type of other dimensions shall be determined, after an actual demonstration, by the supervising inspector of the district in which the boat is accepted. (Sec. 4488, R. S.)

INCLOSED LIFEBOATS.

27. All steamers carrying passengers shall be equipped with at least one lifeboat of approved open standard type. Where two lifeboats are required, one of the same may be of an approved inclosed type. Where three or more lifeboats are required, two of such lifeboats shall be of approved open standard type, one to be carried on each side under davits. In no case shall the lifeboat equipment of any steamer consist of more than 50 per cent of approved lifeboats of inclosed type.

When the approved inclosed type of lifeboat is carried on steamers other than those carrying passengers, such steamers shall also be equipped with one lifeboat of approved open standard type of not less than 180 cubic feet capacity. (Sec. 4488, R. S.)

NEWCOMB INCLOSED LIFEBOAT.

28. Lifeboat of this type, 26 feet in length, 6 feet 4 inches in breadth, and 3 feet 4 inches in depth, when constructed in accordance with the rules for lifeboats, shall be allowed to carry 25 persons.

The number of persons allowed to be carried by boats of this type of other dimensions shall be determined, after an actual demonstration, by the supervising inspector of the district in which the boat is accepted. (Sec. 4418, R. S.)

LUNDIN LIFEBOATS.

29. *Lundin decked lifeboats* shall be rated and accepted as lifeboats under davits, and may be placed in nests of two under a single pair of davits. They shall be fully equipped as lifeboats as required by these rules and regulations, and shall be measured in accordance with the following formula:

Where cubic capacity=L×B×D×0.9 cubic feet.
L=length over all. in feet.
B=width over fenders, in feet.
D=depth from top of keel to top of gunwale, in feet.

Example.

28 feet×9.5 feet×2.5 feet×0.9=598.5 cubic feet.
Allow 10 cubic feet to a person, 598.5÷10=59 persons.

Provided, That when the Lundin decked lifeboat is loaded to its full capacity the water-tight deck shall be not less than 2 inches above the load water line, and shall have an excess buoyancy in air space and fenders of not less than 25 per cent of the combined weight of boat and load. Not less than 10 per cent of the total buoyancy shall be in fenders of buoyant material firmly secured to the outside of the boat.

The following example is given in explanation of the above proviso:

Example.

26 feet, 50 persons, Lundin decked lifeboat.

Height of load water line, 15 inches. Required height of inner deck=15 inches+2 inches=17 inches. Combined weight of boat and load (each person allowed figured at 165 pounds), 12,250 pounds. Excess buoyancy required in air space and fenders above=0.25× 12,250=3,062.5 pounds. Total buoyancy required, i. e., buoyancy of air space below water-tight deck plus buoyancy of entire fenders,= 12,250+3,062.5=15,312.5 pounds. Buoyancy required in entire fenders=0.10×15,312.5=1,531.25 pounds.

The carrying capacity of the Lundin *power* lifeboat shall be determined by the same rule as the Lundin decked lifeboat, with proper reduction for the weight and space used for the motors, tanks for fuel, and wireless apparatus.

The carrying capacity of the Lundin *housed* lifeboat shall be determined by the same rule as the Lundin decked lifeboat.

Lundin semidecked lifeboats shall be rated and accepted as lifeboats under davits, and may be placed in nests of two under a single pair of davits. They shall be fully equipped as lifeboats as required by these rules and regulations, and shall be measured in accordance with the following formula:

Cubic capacity=L×B×D×0.9 cubic feet.

Where L=length over all, in feet.
B=width over fenders, in feet.
D=depth from top of keel to top of gunwale, in feet.

Example.

20 feet×7 feet×2 feet×0.9=252 cubic feet.
Allowing 10 cubic feet to a person, 252÷10=25 persons.

Provided, That the length of the Lundin semidecked lifeboat does not exceed 24 feet; that the above boat is provided with independent air tanks, placed at the sides of the boat, built in accordance with the

general rule for air tanks of lifeboats and with a capacity of not less than 1½ cubic feet for each person allowed; that the above boat is provided with built-in water-tight compartments, one in each end, and provided with a water-tight manhole, and that not less than 10 per cent of the volume of the displacement to the load water line shall be in fenders of buoyant material firmly secured to the outside of the boat.

The Lundin *open* lifeboat with balsa-wood fenders, 24 feet in length, 7 feet 1 inch in breadth inside fender, 8 feet in breadth outside fender, and 3 feet 2 inches in depth, shall be allowed to carry 40 persons. The number of persons allowed to be carried on boats of this type of other dimensions shall be determined, after an actual demonstration, by the supervising inspector of the district in which the boat is accepted. (Sec. 4488, R. S.)

CHARLES R. M'COTTER LIFEBOAT.

30. Lifeboat of this type, 13 feet in length, 1 foot 10 inches in height, and 4 feet in width, shall be allowed to carry eight persons. The number of persons allowed to be carried on boats of this type of other dimensions shall be determined, after an actual demonstration, by the supervising inspector of the district in which the boat is accepted. In all cases the air tanks in such boats shall be constructed in accordance with the rules and regulations for air tanks. (Sec. 4488, R. S.)

LIFE RAFTS.

DRAWINGS, SPECIFICATIONS, NAME PLATE, AND HOW MARKED.

31. All life rafts shall be substantially constructed in accordance with drawings, or blue prints, and specifications approved by the supervising inspector of the district in which the life rafts are built.

Builders of life rafts shall furnish the supervising inspector of the district in which the life rafts are built drawings, or blue prints, and specifications, showing and explaining the construction of same and showing the tensile strength and ductility of the metal used. The metal used shall have a tensile strength of not less than 40,000 pounds per square inch, and an elongation, in a length of 4 inches, of at least 20 per cent when the thickness of the metal is of, or greater than, No. 16 B. W. G., and 15 per cent when the thickness of the metal is less than No. 16 B. W. G.

Builders of life rafts shall affix a plate or other device to each life raft, having thereon the builder's name, number of raft, date of construction of raft, cubical contents of raft, and number of persons said raft will carry, as determined by the rules of the Board of Supervising Inspectors.

There shall be stenciled in a conspicuous place on each life raft now in use the number of persons said raft can carry, as hereinafter provided. (Secs. 4405, 4488, R. S.)

INSPECTION OF LIFE RAFTS WHEN BUILT.

32. Supervising inspectors of districts where life rafts are built shall detail an assistant or local inspector to any place where life

rafts are being built, whose duty it shall be to carefully inspect and examine the construction of such life rafts, and he shall satisfy himself that such life rafts are constructed in accordance with the drawings, or blue prints, and specifications furnished by the builders. When the assistant or local inspector approves the construction of the raft he shall stamp his initials, together with the letters U. S. I., on a blank space on the plate required to be affixed to the raft by the builder. The initials of the assistant or local inspector shall be satisfactory evidence to all parties interested that the raft has been constructed in accordance with the drawings, or blue prints, and specifications on file.

This section shall apply to all life rafts constructed after June 30, 1912. (Secs. 4405, 4488, R. S.)

CONSTRUCTION OF RAFTS OF THE CATAMARAN TYPE.

33. All metal life-raft cylinders of more than 15 feet in length or of more than 16 inches in diameter shall be constructed of metal not less than No. 18 B. W. G. No life-raft cylinders shall be of less thickness of metal than No. 20 B. W. G.

The retaining bands which secure the cylinders to the frames shall be made in halves, so that the cylinders may be detached without difficulty and without disassembling the body of the raft, for the purpose of inspection, cleaning, and painting, as required by section 35. Wooden guards and gunwales shall be secured to the retaining bands by angle-iron clips or by the jaws of the retaining bands. Iron rods extending across the raft at top and bottom shall pass through the gunwale and its securing clips or jaws at each end of the raft. The ends of the rods shall be properly secured with a screw nut inside and outside of the gunwale.

All such cylinders shall be divided by water-tight bulkheads into not less than three compartments of equal lengths. Cylinders over 9 feet in length shall be divided into equal lengths by water-tight bulkheads into not less than one compartment for every 3 feet of its length. One of such bulkheads shall be at the extreme end of each cylinder or as near thereto as the flange of cone or bumped ends will permit. Each compartment shall be provided with a suitable air-pump connection of one-half inch outside diameter, fitted with air-tight cap.

Only countersunk-headed rivets shall be used in the construction of metallic life rafts.

All seams and joints shall be properly double riveted.

The above provisions of this section shall take effect only as to life rafts constructed after December 31, 1908.

The circumferential as well as the longitudinal seams of life-raft cylinders shall be riveted and tightly calked, or securely hook jointed and efficiently soldered, or properly and securely welded on rafts constructed after June 30, 1905. Such longitudinal seams shall be secured by not less than 12 rivets to each foot, circumferential seams by not less than 10 rivets to each foot, and bulkheads by not less than 8 rivets to each foot. Bulkhead flanges may be single riveted. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

The framework connecting the cylinders of metallic life rafts shall be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in surf or seaway.

No type of raft may be approved unless it satisfies the following conditions:

First. It should be reversible.

Second. It should be of such size, strength, and weight that it can be handled without mechanical appliances, and, if necessary, be thrown from the vessel's deck.

Third. It must have not less than 3 cubic feet of air cases or equivalent buoyancy and not less than 3 square feet of deck surface for each person allowed. Rafts already in use may have the rating changed by the supervising or local inspectors of the district where the same are being used to meet these requirements and allowances.

Fourth. The air tanks or equivalent buoyancy should be placed as near as possible to the sides of the raft.

At least one-half of the number of life rafts on all steam vessels shall have a capacity exceeding 15 persons.

Tule and all other types of catamaran life rafts shall meet the requirements herein specified. (Secs. 4405, 4488, R. S.)

TESTS OF AIR TANKS OF LIFE RAFTS.

34. Before any life raft is passed and accepted, the air tanks thereof shall be tested in the presence of an inspector of this service by an air pressure of not more than 1 pound to the square inch. At each subsequent annual inspection, or oftener, if in the opinion of the inspectors it is necessary or desirable, the inspectors shall satisfy themselves that the tanks are in good condition, but pressure need not be applied unless the inspectors are in doubt regarding the efficiency of the tanks. This does not take from the inspectors the right and authority to satisfy themselves at any time, either by examination or pressure, as to the condition of the tanks. (Secs. 4405, 4488, R. S.)

CARE OF LIFE RAFTS.

35. All life rafts shall be stripped, cleaned, painted, and thoroughly overhauled at least once in every year, and inspectors shall carefully examine at all inspections the material which supports the platform of all life floats in order to determine to their satisfaction that the strength is maintained. If it is found that deterioration has begun, it shall be corrected even to the extent of requiring the renewal of the platform-supporting device. (Secs. 4405, 4488, R. S.)

APPROVED LIFE RAFTS.

36. Any type of life rafts approved by the Board of Supervising Inspectors shall be considered as equivalent to the standard raft above specified. (Secs. 4405, 4488, R. S.)

CAPACITY AND ALLOWANCE OF ENGELHARDT COLLAPSIBLE LIFEBOATS.

37. Engelhardt collapsible lifeboats may be carried as lifeboats and rated as class 2C.

When the Engelhardt collapsible lifeboat is allowed as a lifeboat, it shall be carried under the davits, with sides of boat fully extended, and only one Engelhardt collapsible lifeboat shall be allowed to be carried under one set of davits, except that one nest of two Engelhardt collapsible lifeboats shall be allowed to be carried under one set of davits on each side of steam vessels of 2,500 to and including 5,000 gross tons, and one nest of three Engelhardt collapsible lifeboats shall be allowed to be carried under one set of davits on each side of steam vessels of over 5,000 gross tons, and when so nested the sides may be collapsed.

Engelhardt collapsible lifeboats shall be fully equipped as lifeboats as required by these rules and regulations.

The cubic capacity of Engelhardt collapsible lifeboats shall be determined in accordance with the following rule: Measure in feet and fractions of a foot the length and breadth outside of canvas extension and the depth inside at the place of minimum depth taken from the inside of the bottom planking of the bottom to the top of gunwale when extended. The product of these dimensions multiplied by 0.7 shall be deemed the capacity in cubic feet. (Secs. 4405, 4488, R. S.)

38. CARLEY LIFE FLOATS.

No. of float.	Size of float.	Diameter of tube.	Minimum number of compartments.	Number of persons carried and allowed.
		Inches.		
1	8 by 4 feet	14¼	.....	10
2	8 by 5 feet	16¼	.....	11
3	10 by 6 feet	17¼	.....	18
4	12 by 8 feet	20¼	.....	33
5	3 feet 6 inches by 6 feet	12	8	6
6	3 feet 9 inches by 6 feet 6 inches	13	8	7
7	4 by 7 feet	14	8	9
8	4 feet 6 inches by 7 feet 6 inches	14	10	11
9	4 feet 6 inches by 8 feet 6 inches	14	12	13
10	5 by 8 feet	14	12	13
11	do	15	12	13
12	5 by 9 feet	15	14	16
13	5 by 10 feet	15	14	17
14	6 by 10 feet	16	.....	28
15	6 feet 6 inches by 10 feet 6 inches	17	.....	31
16	7 by 12 feet	18	.....	41
17	8 by 12 feet	19	.....	45
18	9 by 14 feet	20	.....	67
19	5 by 8 feet	14½	.....	18
20	5 by 10 feet	15½	.....	20

(Secs. 4405, 4488, R. S.)

CAMBRIDGE LIFE FLOAT.

39. The Cambridge life float 9 feet in length and 6 feet 6 inches in width shall be allowed a capacity of 25 persons. Other sizes of the same type shall be allowed a capacity comparing approximately

with the above capacity, which shall be determined by the supervising inspector of the district where the float is manufactured, after an actual demonstration. (Secs. 4405, 4488, R. S.)

SWEENEY LIFE FLOAT.

40. The Sweeney life float 8 feet 4 inches in length and 5 feet 6 inches in width shall be allowed a capacity of 14 persons. Other sizes of the same type shall be allowed a capacity comparing approximately with the above capacity, which shall be determined by the supervising inspector of the district where the float is manufactured, after an actual demonstration. (Secs. 4405, 4488, R. S.)

CLARK LIFE RAFTS.

41. Clark life rafts shall be constructed, tested, and rated in accordance with the following specifications:

All cylinders of more than 16 inches in diameter shall be constructed of metal not less than No. 18 B. W. G., and no cylinder shall be of less thickness of metal than No. 20 B. W. G. Cylinders shall be provided with a suitable air-pump connection of one-half inch outside diameter, fitted with air-tight cap.

The inspection of life rafts shall include the testing of each compartment by air pressure.

The circumferential as well as the longitudinal seams of cylinders shall be riveted and tightly calked, or securely hook jointed and efficiently soldered, or properly and securely welded. Such longitudinal seams shall be secured by not less than 12 rivets to each foot, circumferential seams by not less than 10 rivets to each foot, and bulkheads by not less than 8 rivets to each foot.

Only countersunk-headed rivets shall be used in the construction of cylinders. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

The framework connecting the cylinders shall be substantially built and capable of resisting the strain which tends to break the raft apart when the raft is broadside on in surf or when in seaway.

On and after May 1, 1917, the iron or steel bolts and nuts used in the construction of Clark rafts for service on salt water shall be galvanized. Nuts shall not be countersunk in the wood frame, but shall be protected by a wooden batten properly fitted over the nuts and fayed neatly to the frame. (Sec. 4488, R. S.)

A B C LIFE RAFTS.

42. The A B C life raft shall be allowed for use upon vessels under the jurisdiction of the Steamboat-Inspection Service, and upon all waters, except offshore ocean service, when constructed in accordance with the blue prints and specifications submitted, and allowed a capacity in accordance with the following table:

No. of raft.	Dimensions of raft.		Diameter of cylinder.	Number of persons allowed.
	Length.	Width.		
	Ft. In.	*Ft. In.*	*Inches.*	
1	5 0	2 6	6	5
2	7 0	3 6	8	10
3	7 6	3 6	9	14
4	8 0	5 0	10	20
5	8 9	4 9	11	25
6	10 0	6 0	13	40
7	12 0	8 0	15	60

The cylinder shall be made of solid, encysted balsa wood, well treated with Marr's process in finished state, so as to insure buoyancy. Cylinder shall be covered with heavy canvas, and suspended from the cylinder shall be a strong, substantial net, at the bottom of which is fixed a platform of sufficient strength to sustain the number of persons allowed.

The A B C raft shall be capable of sustaining for a continuous period of 24 hours a load placed upon the submerged platform of at least 20 pounds for each person that the raft is allowed in accordance with the table. The A B C rafts shall be carefully inspected, tested, and marked by inspectors of this service, in accordance with the requirements of Rule III governing such inspection, testing, and marking.

USE OF BARSTOW LIFE RAFT PROHIBITED.

43. The use of the Barstow life raft is prohibited on vessels on any waters after February 28, 1914. (Sec. 4488, R. S.)

CATAMARAN TULE LIFE RAFTS.

44. Catamaran tule life rafts of the sizes specified below shall be allowed the following rating:

Length.	Diameter of cylinders.	Number of persons allowed.
Feet.	*Inches.*	
8	20	8
12	20	12
16	20	17
18	20	18
20	20	20

Catamaran tule life rafts having cylinders of a smaller diameter than specified above shall be tested by the local inspectors of the district in which they are built to determine the number of persons allowed to be carried by such rafts, which test shall consist of a practical demonstration. (Sec. 4488, R. S.)

EQUIPMENT FOR LIFE RAFTS.

45. All life rafts on vessels of classes (*a*), (*b*), (*c*), and (*d*) on the Great Lakes shall be equipped as follows:

A properly secured life line entirely around the sides and ends of the raft, festooned to the gunwales in bights not longer than 3 feet, with a seine float in each bight.

One painter of manila rope of $2\frac{3}{4}$ inches in circumference, and of suitable length.

Four oars.

Five rowlocks properly attached.

One boat hook attached to a staff of suitable length.

One self-igniting life-buoy light.

One sea anchor.

A vessel containing 1 gallon of vegetable or animal oil, so constructed that the oil can be easily distributed on the water, and so arranged that it can be attached to the sea anchor.

A water-tight metal case containing six self-igniting red lights capable of burning at least two minutes.

A water-tight box of matches.

All loose equipment must be securely attached to the raft to which it belongs.

All life rafts on vessels of class (*f*) shall be equipped with a life line running entirely around the sides and ends of the raft festooned to the gunwales with a seine float in each bight, the bights to be not longer than 3 feet; 1 painter, of $2\frac{3}{4}$-inch (about 0.9 inch diameter) manila rope of a suitable length.

Rafts for 6 persons or less shall be equipped with 2 oars, 2 paddles, 3 rowlocks, and 1 boat hook; rafts for 7 to 10 persons, 4 oars, 2 paddles, 4 rowlocks, and 1 boat hook; rafts for over 10 persons, 4 oars, 2 paddles, 4 rowlocks, 1 steering oar with rowlock or becket, and 1 boat hook.

The oars mentioned in this section shall be of a suitable size and the paddles of not less than 5 feet in length, the blade of each paddle to be of not less area than one-half that of the blade of one of the oars of such raft.

All the equipment mentioned in this section shall be kept in good condition for immediate use, and the rowlocks shall be attached to the raft with chain. (Secs. 4405, 4488, R. S.)

HANDLING OF THE BOATS AND RAFTS.

46. All the boats and rafts must be stowed in such a way that they can be launched in the shortest possible time and that, even under unfavorable conditions of list and trim from the point of view of the handling of the boats and rafts, it may be possible to embark in them as large a number of persons as possible.

The arrangements must be such that it may be possible to launch on either side of the vessel as large a number of boats and rafts as possible.

CERTIFICATED LIFEBOAT MEN—MANNING OF THE BOATS.

47. There shall be for each boat or raft a number of lifeboat men at least equal to that specified as follows: If the boat or raft carries 25 persons or less, the minimum number of certificated lifeboat men shall be 1; if the boat or raft carries 26 persons and less than 41 persons, the minimum number of certificated lifeboat men shall be 2; if the boat or raft carries 41 persons and less than 61 persons, the minimum number of certificated lifeboat men shall be 3; if the boat or raft car-

ries from 61 to 85 persons, the minimum number of certificated lifeboat men shall be 4; if the boat or raft carries from 86 to 110 persons, the minimum number of certificated lifeboat men shall be 5; if the boat or raft carries from 111 to 160 persons, the minimum number of certificated lifeboat men shall be 6; if the boat or raft carries from 161 to 210 persons, the minimum number of certificated lifeboat men shall be 7; and, thereafter, 1 additional certificated lifeboat man for each additional 50 persons: *Provided*, That if the raft carries 15 persons or less a licensed officer or able seaman need not be placed in charge of such raft: *Provided further*, That one-half the number of rafts carried shall have a capacity of exceeding 15 persons.

The allocation of the certificated lifeboat men to each boat and raft remains within the discretion of the master, according to the circumstances.

By "certificated lifeboat man" is meant any member of the crew who holds a certificate of efficiency issued under the authority of the Secretary of Commerce.

In order to obtain the special lifeboat man's certificate the applicant must prove to the satisfaction of an officer designated by the Secretary of Commerce that he has been trained in all the operations connected with launching lifeboats and the use of oars; that he is acquainted with the practical handling of the boats themselves; and, further, that he is capable of understanding and answering the orders relative to lifeboat service.

MANNING OF BOATS.

48. A licensed officer or able seaman shall be placed in charge of each boat or pontoon raft; he shall have a list of its lifeboat men, and other members of its crew which shall be sufficient for her safe management, and shall see that the men placed under his orders are acquainted with their several duties and stations.

A man capable of working the motor shall be assigned to each motor boat.

The duty of seeing that the boats, pontoon rafts, and other lifesaving appliances are at all times ready for use shall be assigned to one or more officers.

LIFE PRESERVERS.

49. Every vessel inspected under the provisions of Title LII, Revised Statutes of the United States, shall be provided with one good life preserver, having the approval of the Board of Supervising Inspectors, for each and every person carried, *and every vessel carrying passengers shall have in addition thereto a number of life preservers suitable for children equal to at least 10 per cent of the total number of persons carried.*

Every life preserver adjustable to the body of an adult person, manufactured after June 1, 1919, shall be of the reversible type, made of suitable material approved by the Board of Supervising Inspectors, with belts properly attached on each side of the body of the life preserver (thus making it reversible), with recesses for armholes under the arms, thereby allowing the front and back sections to fit around the upper part of the wearer, and held in place by the belts, and the

upper part of the life preserver shall be made vest like, the whole so constructed as to place the main buoyant body of the device underneath the shoulders and around the body in a manner to hold the person wearing it in a slightly backward reclining position when in an inert or unconscious condition.

All such life preservers shall be not less than 52 inches in length when measured laid flat, and every life preserver shall be capable of sustaining for a continuous period of at least 24 hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life preserver of at least 20 pounds.

The top part of such life preserver shall have a collar for supporting the head of the wearer as a permanent part thereof, padded or filled with approved material equal in buoyancy to that of 10 ounces of prime Java kapok, with reversible collar straps permanently attached to secure such collar about the neck of the wearer.

All life preservers shall be covered with uncolored material without filling or sizing, of sufficient weight and strength to fully protect the contents, such material to be unbleached cotton drill or twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on the body of each life preserver shall be of one piece only and the outside longitudinal edge of the covering seam shall be turned to a roll and closely rope stitched: *Provided*, That the material used in construction of the vest-like top and supporting collar may be made of separate pieces of like material of the same weight, gored to fit, and securely sewed by a double row of stitching to top of such life preserver. The collar where same joins the top of life preserver shall be securely stitched thereto, said stitching to be doubly reinforced at the front.

The two belt straps, or other approved means of securing the life preserver about the body of the wearer, shall be of double-woven cotton tape 1¼ inches wide, extending along the middle line of both sides of the life preserver, and secured thereto in a permanent manner as to make such life preserver reversible, the ends of the belt extending 12 inches beyond the ends of the jacket.

The collar straps shall be four in number, 18 inches in length, and of heavy double-woven cotton tape 1¼ inches wide attached 8 inches back from the front ends, one on each side of each front end of the collar securely sewed by at least four rows of stitching, ends of tapes to be doubled where sewed.

All thread used in the construction of life preservers shall be linen of a size and strength not less than Barbour's three-cord, No. 25, machine thread. All seams and other machine sewing on life preservers shall be with a short lock stitch, not less than eight stitches to the inch.

Cork block life preservers shall contain an aggregate weight of 5½ pounds of good cork in the body thereof, and where the blocks of life preservers are made up of separate pieces of cork, said pieces shall be fastened with noncorrosive materials.

Blocks of compressed cork when used in life preservers shall weigh in the aggregate not less than 5½ pounds in the body of jacket to each life preserver and shall be so constructed that said blocks will sustain, without disintegration or substantial expansion, a submersion test satisfactory to the inspector examining the same,

and that at the expiration of such test shall have the buoyancy above required.

Blocks of balsa wood or sheaves of tule when used in life preservers shall fulfill the same requirements as for life preservers constructed of solid or compressed cork, as to construction, material in cover, belts and thread, and be subjected to similar tests for buoyancy.

The edges, corners, and outside surface of block material used in the construction of life preservers shall present a smooth surface to guard against undue destruction of the covering material and present suitable smooth surface for legible stenciling and stamping by the inspectors making the inspection.

Kapok, when used in the body of the life preserver, shall weigh in the aggregate 1½ pounds and shall be prime Java kapok, and when used for the collar filling shall be of the same grade of kapok, such collar filling to weigh in addition the aggregate of 10 ounces. The body and collar filling of such kapok life preserver shall be suitably and efficiently quilted, and every such kapok collar shall be capable of sustaining for a continuous period of at least 48 hours an attached weight so arranged that whether the weight be submerged or not there shall be a direct downward gravitation pull of at least 11 times the weight of the completed collar, or collar sample undergoing the test. Such kapok supporting collars and all other supporting collars shall be subjected to buoyancy test separate and independent to that of the test required for the body of the life preserver. (See test for kapok, under heading "Kapok Life Preservers.")

On and after the approval of this rule every type of life preserver submitted to the Board of Supervising Inspectors for approval shall be accompanied by specifications, blue prints, or drawings, in triplicate, and no such type of life preserver shall be approved without an actual satisfactory service test being witnessed by the Board of Supervising Inspectors, an executive committee thereof, or by the Committee on Life-Saving Appliances.

After June 1, 1919, no life preserver shall be passed at the factory inspection which does not fulfill the foregoing requirements, but life preservers now in use or already passed at factory inspection may be used on board vessels, provided they are contructed in accordance with the laws and regulations in force up to the date of June 1, 1919, and are in good and serviceable condition: *Provided*, That life preservers that have deteriorated to the extent of requiring new covers may be used upon vessels under the jurisdiction of this service, when repaired in a manner to conform in every particular with the foregoing requirements: *Provided further*, That nothing in the foregoing rule shall prevent the use of re-covered and repaired life preservers upon inspected steam vessels navigating the Great Lakes, classes (*b*) and (*c*), during the summer months or so-called excursion season, when repaired and re-covered in conformity to the requirements in effect prior to June 1, 1919.

Inspectors are required to direct such life preservers to be distributed throughout the cabins, staterooms, berths, and other places convenient for passengers on such steamers, and there shall be a *printed notice* posted in every cabin and stateroom and in conspicuous places about the deck, informing passengers of the location of

life preservers and other life-saving appliances, and of the mode of applying or adjusting the same. Life preservers on passenger, excursion, and ferry steamers when stowed overhead shall be so supported that they can be quickly released and distributed among the passengers, and the inspector shall satisfy himself as to the efficiency of the means used for such purpose by actual experiment. And when such life preservers are stowed overhead at a height greater than 7 feet from the deck below, efficient means shall be provided for such immediate release and distribution to be operated by persons standing on the deck below.

The supervising inspector of the district shall detail a local or assistant inspector to any place where life preservers are manufactured, whose duty it shall be to test and examine all life preservers manufactured at that place and satisfy himself that such life preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination, and certifying that they have been examined and passed. When life preservers are so stamped it shall be prima facie evidence that they comply with the requirements of law and regulations as to their original construction, and they may thereafter be accepted by inspectors, in their discretion, as being in accordance with the rules and regulations of the Board of Supervising Inspectors.

At each annual inspection of steam vessels, and oftener if deemed necessary, it shall be the duty of the inspectors making the inspection to examine and inspect all life preservers in the equipment of such vessel and satisfy himself (or themselves) that such life preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination and certifying that they have been examined and passed: *Provided*, That at the annual inspection of a vessel, or oftener, if necessary, at least 5 per cent of all kapok life preservers, or such greater number as may be deemed necessary or desirable, shall be subjected to a buoyancy test, as follows: Life preserver containing kapok as buoyant material in the body thereof shall be subjected to a test for buoyancy by being entirely submerged for a period of two hours, after which it shall be capable of sustaining in water an attached weight having an actual downward gravitation pull of 20 pounds when the weight is submerged, and kapok life preservers with kapok collars shall be subjected to a similar test, except that the attached weight shall have an actual downward gravitation pull of 28 pounds when the weight is submerged. Any such life preserver failing to meet the required test shall be immediately condemned and removed from the vessel's equipment, and a full detailed report of every such failure shall be immediately forwarded to the supervising inspector of the district having jurisdiction.

Inspectors inspecting *Government vessels* upon request of any department of the Government may accept life preservers made under the specifications of any department of the Government, and stamp same with the inspector's stamp and an additional stamp bearing the legend U. S. within a circle for identification, with the understanding that they are not to be used except upon Government

vessels and will not be allowed as any part of the equipment of vessels under the jurisdiction of this Service.

Every life preserver for the use of children shall be made of suitable material approved by the Board of Supervising Inspectors, capable of sustaining in water a weight of 10 pounds for a period of 24 hours, and of the same general form of construction as to material and design as required for an adult life preserver.

Life preservers which depend upon *inflation or air compartments* for buoyancy, or which are constructed of *loose granulated material* or any other material not approved by the Board of Supervising Inspectors, shall not be allowed.

Any life preserver hereafter approved by the Board of Supervising Inspectors may be accepted in lieu of those specified in this section. (Sec. 4488, R. S.)

KAPOK LIFE PRESERVERS.

Every type of kapok life preserver used on any vessel subject to inspection by this Service shall first be approved by the Board of Supervising Inspectors.

The life preservers receiving such approval shall conform in every respect to the sample submitted to the board.

Kapok life preservers, to receive the approval of the board, shall be simple in design, and of a character to hold the body of the wearer in an upright position while in the water.

The life preserver shall be filled with 1½ pounds of prime Java kapok.

It shall be tested for buoyancy as follows:

First. At least 1 life preserver from each lot of 250 shall be selected indiscriminately by an inspector of this Service for buoyancy test.

Second. The life preserver shall be submerged in a tank of fresh water for a period of 48 hours.

Third. The life preserver shall then support in fresh water a submerged weight of 20 pounds for a period of 24 hours.

All approved kapok life preservers shall be marked in the following manner:

First. With the name and address of the manufacturer.

Second. The front compartment shall be marked "Front" and the back compartment marked "Back."

Third. Each life preserver shall be marked on the front compartment "Adults," if for the use of adults; and "Children," if for the use of children; and if of a character suitable for the use of both adults and children, it shall be so marked.

For each lot of 250 life preservers, the manufacturer shall submit to the local inspectors of the district in which manufactured an affidavit setting forth the material with which the life preservers are filled and that the life preservers meet in every respect the requirements of the General Rules and Regulations of the Board of Supervising Inspectors.

Every life preserver meeting the above requirements shall be inspected by an inspector of this Service and stamped with his initials if meeting the above requirements. (Sec. 4488, R. S.)

RING LIFE BUOYS.

50. The minimum number of life buoys with which vessels are to be provided is fixed as follows:

Vessels under 100 feet in length, minimum number of buoys, 2; vessels 100 feet and less than 200 feet in length, minimum number of buoys, 4, of which 2 shall be luminous; vessels 200 feet and less than 300 feet in length, minimum number of buoys, 6, of which 2 shall be luminous; vessels 300 feet and less than 400 feet in length, minimum number of buoys, 12, of which 4 shall be luminous; vessels 400 feet and less than 600 feet in length, minimum number of buoys, 18, of which 9 shall be luminous; vessels 600 feet and less than 800 feet in length, minimum number of buoys, 24, of which 12 shall be luminous; vessels 800 feet and over in length, minimum number of buoys, 30, of which 15 shall be luminous.

Ring life buoys shall be of solid cork or any other equivalent material, shall be of not less than 30 inches outside diameter and not less than 17 inches inside diameter, and shall be capable of sustaining in fresh water for a continuous period of 24 hours an attached weight so arranged that, whether said weight be submerged or not, there shall be a direct downward gravitation pull upon the buoy of not less than 31 pounds. The body of the buoy before being covered shall stand a downward gravity pull of 200 pounds, the weight to be attached to the buoy body by a sling covering a surface of 2 linear inches, without breaking, without rupture of the joints, or without showing a maximum elongation of internal diameter in excess of $1\frac{1}{2}$ inches while the weight is attached after being under this test for a period of 30 minutes.

The buoy shall be covered with cloth of sufficient weight and strength to fully protect the body of the buoy. Such material shall be of a strength equivalent to an unbleached single-filling cotton duck having a weight of 8 ounces to a section 36 by 36 inches.

The cover shall be constructed and placed on the body of the buoy in a substantial manner. All seams and other machine sewing on the buoy shall be with a short lock stitch not less than eight stitches to the inch. The inside seam shall be sewed with a rope stitch not less than three stitches to the inch.

Four beckets $2\frac{1}{2}$ inches wide, made from the same material as the covering of the buoy, shall be securely attached to the buoy and spaced an equal distance from each other. A line shall pass through the beckets, which shall be sewed tightly together to prevent slipping. The line shall be manila, three-eighths inch in diameter, three-ply medium lay, of good quality, having the ends securely and neatly spliced, the line to be festooned in bights around the outer edge of the buoy. All thread used in the construction of the buoy shall be No. 16, three-cord linen.

When the buoy is made of cork, the cork form shall be constructed of sound, buoyant corkwood, in two layers or thicknesses. The cork sheets shall be flattened and smoothed so that the back or outside hard crust is removed sufficiently to give a smooth surface for gluing. One layer shall be built of segments not to exceed four in number. The other layer may be built of segments not to exceed eight in number. The ends of all segments shall be fitted neatly and glued

securely one to the other. The two layers shall be neatly joined and properly and securely dowel-pinned and glued firmly together, with joints staggered or broken. The glue used shall be insoluble in water, and the finished buoy shall stand steaming at a pressure of 2 pounds for a period of 30 minutes without disintegration or other positive indications of the glue losing its adhesive properties. When completed, the outside of the buoy shall be of good, sound corkwood, finished to a smooth surface. Any form of construction which will meet the general purposes of the above specifications and requirements may be used after having been approved by the Board of Supervising Inspectors.

The supervising inspector of the district shall detail a local or assistant inspector to any place where cork ring life buoys are manufactured within his district, whose duty it shall be to test and examine all such buoys manufactured at that place. When a cork ring life buoy is found to be in accordance with the requirements of the rules of the Board of Supervising Inspectors, the inspector shall stamp the cork, and after completion of the buoy, shall stamp the cover with the word "Passed," his initials, the inspection port, and the date of approval. The cork and the cover shall also be stamped by the manufacturer with the name or trade-mark of the manufacturer.

Balsa-wood A B C ring life buoys shall be constructed of good, fresh, sound balsa wood and shall be made in two layers with not more than four pieces in each layer, the same to be properly and securely dowel-pinned, and shall be of not less than 30 inches outside diameter and not less than 17 inches inside diameter, and of sufficient buoyancy to sustain the specified weight and give the buoyancy required, and shall be covered with the same weight canvas, stitched, roped, and marked or stamped as required by the specifications for cork ring life buoys.

The use of kapok, rushes, cork shavings, granulated cork, or any other loose granulated material, or compartments which depend on inflation for their buoyancy are not allowed in the manufacture of ring life buoys.

Ring life buoys shall not be permanently secured in any way, but shall be so placed as to be readily accessible in an emergency. Their location shall be plainly indicated.

One of the buoys on each side of the vessel shall have a life line attached of at least 15 fathoms in length.

Luminous buoys are those having attached an efficient self-igniting light which can not be extinguished in water.

SELF-IGNITING WATER LIGHTS.

51. The self-igniting water lights for ring buoys shall consist of a cylinder made of the best grade of 107-pound tin plate or equally efficient material, painted on the outside with not less than two coats of the best oil paint of zinc or lead base, and shall be so designed as to be nonexplosive, and shall be free from any defects which may affect the serviceability or operation of the light. The cylinder shall be sufficiently weighted in the bottom to recover and maintain an upright position in the water, and all circumferential and horizontal seams of the cylinder shall be hook jointed and soldered, *and the top*

circumferential seam shall be flush, so as to prevent the lodgment of water.

The cylinder shall be provided with a plug or other device of such character that when removed from the cylinder sufficient water will be admitted to insure the prompt and efficient action of the light, regardless of whether or not the cylinder when first striking the water becomes completely submerged.

The removal of the plug or device shall be effected by the operation of a lanyard attached to the buoy and to the plug or device on the cylinder, and shall be so arranged and constructed that the weight of the buoy when thrown overboard will automatically disengage the plug or device, and will insure that the light will self-ignite within one minute after reaching the surface of the water.

The cylinder shall contain sufficient calcium carbide and calcium phosphide to create a brilliant flame of at least 150 candlepower, which shall be maintained and burn for a continuous period of not less than 45 minutes without emitting obnoxious fumes. If at any time during this period the flame is extinguished, due to the total submersion of the light, the light shall self-ignite upon coming to the surface.

The self-igniting water lights required for life rafts shall meet the above requirements, except that the plug or device may be removed by manual action instead of by automatic action of the buoy lanyard above referred to.

The cylinders shall be plainly and permanently indented or embossed with the name and address of the manufacturer, the year of manufacture, and with the statement that the device meets in every way the requirements of the Board of Supervising Inspectors.

After June 1, 1916, no type or make of water light will be approved which has not been tested by the Bureau of Standards, Department of Commerce, and found to conform in all respects to these requirements.

Water lights installed on vessels previous to the adoption of the present requirements will be allowed to remain in service so long as they are maintained in good and serviceable condition, but all water lights hereafter manufactured shall be in conformity in all respects with these requirements.

These rules for water lights shall be effective on and after June 1, 1920.

EXTRA STEERING APPARATUS, LADDERS, STAIRWAYS.

52. Extra steering apparatus consisting of relieving tackles or tiller shall be provided for all steamers: *Provided, however*, That where a steamer is equipped with auxiliary steam or hand steering gear attached to rudder entirely independent of the regular steering gear, same may be used in lieu of the relieving tackles or tiller required.

Every steamer or barge carrying passengers shall be provided with suitable ladders, to enable passengers to descend conveniently to the lifeboats and life rafts, such ladders to be placed near each side of the vessel.

Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with perma-

nent stairways forward and aft, except where said stairways on towing boats would interfere with towing bitts. (Secs. 4405, 4480, 4484, R. S.)

BULKHEADS.

53. Every steam vessel navigating the great northern and northwestern lakes, constructed after July 1, 1912, carrying passengers, shall have a water-tight collision bulkhead. In vessels not over 200 feet in length this bulkhead shall be located about one-tenth the vessel's length from stem. In vessels over 200 and not over 350 feet in length the collision bulkhead shall be located about one-twelfth the vessel's length abaft the stem. In vessels over 350 and not over 500 feet in length it shall be located about one-fifteenth the vessel's length abaft the stem, and in vessels over 500 feet in length, about one-sixteenth the vessel's length abaft the stem. Such vessels shall also have one water-tight bulkhead forward of and one abaft the engine and boilers, and in addition thereto shall have such other water-tight bulkheads as may be necessary to provide that there shall be no space between the bulkheads to exceed in length one-fifth the length of the vessel: *Provided, however*, That in no case shall the distance between the bulkheads be greater than 80 feet.

Screw steamers shall, in addition to the above-named bulkheads, have located at a suitable distance forward from sternpost a water-tight bulkhead to protect vessel from disaster in case of fracture of stern pipe.

Wooden steamers carrying passengers whose cargo is restricted to lumber exclusively shall only be required to have a water-tight collision bulkhead as described in the first paragraph of this section, also one water-tight bulkhead forward of and one abaft the engines and boilers.

All such bulkheads shall be of iron or steel plates not less than one-fourth inch thick and shall be securely fastened to suitable framework, which framework shall be properly and securely attached to the hull. Such bulkheads shall be strengthened by vertical bars of not less than 3½ by 3½ inch angle iron, spaced not more than 30 inches from center to center, and all steamers that are more than 10 feet deep in any hold shall have horizontal angle irons of not less than 3 by 3 inches on the reverse side, spaced not more than 4 feet from center to center, in addition to the vertical angle irons: *Provided*, That when any bulkheads are constructed of equal strength to the above-described bulkheads they shall be allowed by the local inspectors.

All bulkheads shall reach to the main deck in single-decked vessels, otherwise to the deck next below the main deck, but in every case they shall reach to the deck next above the deep-load line.[1] (Sec. 4490, R. S.)

[1] SEC. 3. That steam vessels of one hundred tons burden or under engaged in the coastwise bays and harbors of the United States may be licensed by the United States local inspectors of steam vessels to carry passengers or excursions on the ocean or upon the Great Lakes of the North or Northwest, not exceeding fifteen miles from the mouth of such bays or harbors, without being required to have the three water-tight cross bulkheads provided by section forty-four hundred and ninety of the Revised Statutes for other passenger steamers: *Provided*, That in the judgment of the local inspectors such steamers shall be safe and suitable for such navigation without danger to human life, and that they shall have one water-tight collision bulkhead not less than five feet abaft the stem of said steamer. (Act approved July 9, 1886.)

MEANS OF ESCAPE FROM STEAMERS.

54. On all steamers where the plans and arrangements will possibly permit, all inclosures where passengers or crews may be quartered, or where anyone may be employed, shall be provided with not less than two avenues of escape, so located that if one of such avenues is not available another may be. The locality and arrangement of such additional means of escape shall be determined by the steamboat inspectors and the steamboat managers as will in their judgment best carry out the purposes for which this provision was made. (Sec. 4417, R. S.)

STORM OIL.

55. On and after August 1, 1914, all steam vessels of over 200 gross tons navigating the waters of the Great Lakes (except rivers) shall be equipped with oil tanks fitted with suitable hose or pipes for distributing oil overboard whenever weather conditions make the same necessary.

Steamers of over 200 and not over 1,000 gross tons shall be provided with two oil tanks of at least 10 gallons capacity each.

Steamers of over 1,000 and not over 3,000 gross tons shall be provided with two oil tanks of at least 15 gallons capacity each.

Steamers of over 3,000 and not over 5,000 gross tons shall be provided with two oil tanks of at least 20 gallons capacity each.

Steamers of over 5,000 gross tons shall be provided with two oil tanks of at least 25 gallons capacity each.

On steamers where the space and arrangements will permit, the two oil tanks shall be in a protected place in the forward part of the vessel. However, if space does not permit both oil tanks to be placed in the forward part of the vessel, one of the required oil tanks may be placed in the after part of the vessel.

Tanks shall be kept in a good condition and filled with animal or storm oil, ready for use when vessel is being navigated: *Provided, however*, That passenger and excursion steamers navigating during the interval from May 1 to September 15 in any one year are not required to be equipped with oil tanks as specified in this section: *Provided further*, That ferry steamers confined to the ferry routes specified in their certificates of inspection are not required to be equipped with oil tanks as specified in this section. (Sec. 4405, R. S.)

STEAMER'S NAME ON EQUIPMENT.

56. All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used. (Sec. 4405, R. S.)

RULE IV.—FIRE APPARATUS.

1. All steamers navigating the Great Lakes are required to be provided with fire buckets and axes, as follows:

Gross tons.	Buckets.	Axes.
All steamers not over 10 tons	2	1
All steamers over 10 tons and not over 50 tons	4	1
All steamers over 50 tons and not over 200 tons	8	2
All steamers over 200 tons and not over 500 tons	16	4
All steamers over 500 tons and not over 1,000 tons	20	6
All steamers over 1,000 tons	25	8

Fire buckets shall be of a capacity of not less than 3 gallons each, but where buckets already installed are of a capacity of less than 3 gallons each, they may continue to be used, and fire buckets of the standard size shall be added to provide the total capacity required.

Not more than six of the buckets required by this table shall be carried on the upper or boat deck.

Fire buckets shall, when practicable, be constantly filled with water, and in such positions on board as shall be most convenient for extinguishment of fire. (Secs. 4426, 4483, R. S.)

2. All axes shall be located so as to be readily found in time of need, shall not be used for general purposes, and shall be kept in good condition. (Secs. 4426, 4483, R. S.)

3. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin.

All baled cotton shall be securely bound and covered with bagging on at least three-fourths of its surface, including both ends of the bale. No bales of imported or domestic hemp shall be received on any vessel carrying passengers unless the same are properly com-

pressed, bound with rope, wire, or metallic bands, and covered on ends or sides, according to the several methods now practiced in foreign and domestic trade. (Sec. 4472, R. S.)

4. The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same shall be not less than 1½ inches in diameter. Steam pipes of not less than three-fourths of an inch in diameter shall be led to all lamp lockers, oil rooms, and like compartments, which lamp lockers, oil rooms, and compartments, in all classes of vessels, shall be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, the handles distinctly marked to indicate the compartment or parts of the vessel to which they lead.

These valves or their handles shall be placed in not more than two places on the most suitable and accessible deck of the vessel and so arranged that all can be inclosed in cabinets, boxes, or casings, the doors of which shall be plainly marked with the words "Steam fire apparatus."

On all oil-tank steamers the valves, instead of being located near the hatches on the upper deck, shall be all in an accessible house in which the operator is well protected from heat and smoke: *Provided*, That on oil-tank steamers a main line of steam smothering pipe of sufficient area to supply all branch pipes leading from the same to the tanks may be run the entire length of the deck, and only the main stop valve of the main line shall be required to be housed. All branch pipes shall be provided with valves which shall be left open at all times, so that the steam may enter all compartments simultaneously. Such branches as may not be required after the fire is definitely located may be shut off, in order that the entire system may be concentrated on one tank.

Provided, That carbonic-acid gas or other extinguishing gases or vapors may be substituted in place of steam as aforesaid and for the above-described purposes, when such gas or vapor and the apparatus for producing and distributing the same shall have been approved by the Board of Supervising Inspectors: *Provided*, That the use of such apparatus shall be allowed by law.

Provided further, That pipes for conveying steam from the boilers, or pipes for conveying carbonic-acid gas or other extinguishing vapors for the purpose of extinguishing fire, shall not be led into the cabins or into other passengers' or crew's quarters.

Provided further, That on oil-tank steamers and in connection with the fuel-oil tanks or compartments on steamers using oil for fuel, the fire-extinguishing agency known as foamite may be substituted in place of steam, as aforesaid, and for the above-described purposes, when such foamite and apparatus for distributing the same are installed in accordance with drawings or blue prints and specifications approved by the Board of Supervising Inspectors.

The use of glass lamps shall be prohibited on any vessel under the jurisdiction of the Steamboat-Inspection Service unless the same are securely fitted into suitable metal brackets. (Sec. 4470, R. S.)

5. Steamers required to be provided with double-acting steam fire pumps or other equivalents for throwing water shall be equipped

with such pumps according to their tonnage, as follows: Steamers over 20 tons and not exceeding 150 gross tons shall have not less than 50 cubic inches pump-cylinder capacity. Steamers of over 150 gross tons and under 3,000 tons shall have not less than one-third of 1 cubic inch pump-cylinder capacity for every gross ton. Steamers of 3,000 gross tons and over shall have pump cylinder of not less than 1,000 cubic inches capacity. This rule shall apply only to pumps installed after June 30, 1907, and all pumps now approved and in use or installed before said date shall be accepted if complying with requirements of law and regulations in force at the time of the adoption of this rule.

Upon such steamers fire mains shall be led from the pumps to all decks, with sufficient number of outlets arranged so that any part of the steamer can be reached with water with the full capacity of the pumps and by means of a single 50-foot length of hose from at least one of said outlets. On all classes of steamers every such pump shall be fitted with a gauge and a relief valve adjusted to lift 100 pounds pressure. (Sec. 4471, R. S.)

6. Steamers are not restricted to any particular proportions for fire pumps. Any dimensions that will attain the requirements specified in section 5, or greater in capacity, may be allowed: *Provided, however*, That all hydrant connections be supplied with suitable spanners. (Sec. 4471, R. S.)

7. The capacity of the pipes and hose leading from the pumps shall in no case be less than that of the discharge opening of the pump: *Provided, however*, That the pipe and hose shall in no instance be less than 1½ inches in internal diameter.

And provided further, That steamers of 15 tons and under may be allowed to use hose of three-fourths of an inch internal diameter, but in no case shall it be less than the discharge opening of the pumps, it being further provided that open boats of less than 10 gross tons that are fully equipped with buckets, as required by these rules and regulations, shall not be required to carry hose. (Sec. 4471, R. S.)

8. A rotary pump, when driven by an engine independent of the main engine, may be considered as an equivalent for the double-acting fire pump, and used as such when equal to it in efficiency and capacity. (Sec. 4471, R. S.)

9. Any steamer having on board an independent steam pump and an auxiliary boiler suitably arranged and of sufficient strength and capacity for testing the boilers thereof; or if one of the hand fire pumps be suitably arranged and of sufficient strength and capacity for testing the boilers; or if the "doctor," so-called, when arranged permanently for testing the boilers, is, in the judgment of the inspectors, suitable for the purposes intended, may be considered as having complied with the law requiring a pump for testing boilers. (Sec. 4471, R. S.)

10. Any steamer of 50 gross tons or under, required to have a double-acting steam fire pump, and having in use on board a "doctor," so called, may be considered as having a lawful equivalent for such a pump when such "doctor" has pipes attached to it leading to the upper and between decks, such pipes being provided with hose and valves, according to law; but the pipes and hose shall in no case be less than 1½ inches in internal diameter. The pumps for supplying

the boilers shall in no case be considered as an equivalent for the double-acting steam fire pump, on steamers above 50 gross tons. Every steamer exceeding 150 gross tons and not otherwise provided for shall be provided with one good double-acting fire pump to be worked by hand: *Provided*, That when a steam pump is equipped to work by hand the same shall be accepted as a hand fire pump. Each chamber shall be of sufficient capacity and the stroke so regulated that not less than 100 cubic inches of water shall be displaced by each stroke of the piston. Two smaller pumps may be allowed to take the place of the one pump of 100 cubic inches capacity provided for in this section when their combined capacity equals or exceeds 100 cubic inches. Each pump shall be placed in the most suitable part of the vessel for efficient service, having suitable, well-fitted hose to such pump long enough to reach to all parts of the vessel. Pumps may be connected to a pipe line having sufficient number of outlets so arranged that any part of the vessel can be reached with water by means of a single 50-foot length of hose from at least one of said outlets, pumps to be kept at all times in perfect order, with brakes, and hose coupled on ready for immediate use: *Provided*, That on freight steamers having hulls constructed entirely of metal only such hose shall be required as may be necessary to reach all cabins or superstructures, such hose to be coupled on at all times. (Sec. 4471, R. S.)

11. All steam fire pumps required shall be supplied with connecting pipes leading to the hold of the vessel with stopcocks or shut-off valves attached and so arranged that such pumps may be used for pumping and discharging water overboard from the hold

Each and every steam vessel shall be fitted with a bilge pipe leading from each compartment of the vessel and connecting with a suitably marked valve to the main bilge pump in the engine room, and each compartment of all steam vessels shall be fitted with suitable sounding pipe, the opening of which shall be accessible at all times, except that in compartments accessible at all times for examination no sounding tubes are necessary.

Steam siphons may be substituted in each compartment for the bilge pipes.

All hose required on steam vessels for fire purposes shall be tested to a pressure of 100 pounds to the square inch at each inspection, and it shall be the duty of the local inspectors at each annual inspection to see that the couplings are securely fastened to the hose by suitable external or internal clamps, and at least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle: *Provided*. That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading. (Sec. 4471, R. S.)

12. All pipes used as mains for conducting water from fire pumps on board steam vessels in place of hose shall be of wrought iron, brass, or copper, with wrought-iron, brass, or composition hose connections.

Suction pipes for all pumps on steam vessels shall be so arranged as to have an area of opening sufficiently large to supply water when pumps are working at full capacity. (Sec. 4471, R. S.)

FIRE EXTINGUISHERS.

13. All steamers of more than 15 tons, carrying passengers, including pleasure vessels, shall be provided with such number of good and efficient portable fire extinguishers, approved by the Board of Supervising Inspectors, as shall hereafter be prescribed, viz:

	Fire extinguishers.
Steamers of over 15 and not over 50 gross tons	1
Steamers of over 50 and not over 100 gross tons	2
Steamers of over 100 and not over 500 gross tons	3
Steamers of over 500 and not over 1,000 gross tons	6
Steamers of over 1,000 gross tons, not less than	8

Freight and towing steamers of over 250 tons shall be provided with chemical fire extinguishers as hereafter described, viz:

	Fire extinguishers.
Steamers of over 250 and not over 500 gross tons	1
Steamers of over 500 gross tons	2

Extra charges shall be carried on board for 50 per cent of each class of fire extinguishers provided, whether soda and acid, or carbon tetrachloride. If 50 per cent of each class of fire extinguisher carried gives a fractional result, extra charges shall be provided for the next largest whole number.

Example.

Fire extinguishers carried.	Extra charges required.
1	1
2	1
3	2
4	2
5	3

The tables of required fire extinguishers in this section are based on the capacity of the ordinary machine, which is about 2½ gallons, and no fire extinguisher of larger capacity shall be allowed a greater rating than that of the ordinary machine, except as otherwise provided. Fire extinguishers of approved types of less capacity are allowable when their total contents equal the required quantity.

All steamers carrying passengers which transport automobiles or motor vehicles the motive power of which is generated by any of the products of petroleum, or other inflammable liquids, shall carry, in addition to the chemical fire extinguishers required by the preceding table, an approved carbon tetrachloride fire extinguisher of a type approved by the Board of Supervising Inspectors, in accordance with the following table:

Automobiles or motor vehicles carried:	Carbon tetrachloride extinguishers required.
1 and not over 3	2
4 and not over 7	3
8 and not over 12	4
13 and not over 20	5
21 and not over 30	7
31 and not over 40	9
41 and not over 50	11
51 and over (for each 10 or less additional automobiles or motor vehicles)	2

Fire extinguishers shall be located in such parts of the vessels as in the judgment of the local inspectors will be most convenient and serviceable in case of emergency, and so arranged that they may be easily removed from their fastenings. Every fire extinguisher thus provided for shall be discharged and examined at each annual inspection.

Every fire extinguisher provided for and required by this section shall be tested by the Bureau of Standards, Department of Commerce, and a report made by that bureau to the Board of Supervising Inspectors, which shall then determine whether the said extinguisher shall be approved for use on vessels subject to inspection.

NOTE.—As a result of examinations and tests by the Bureau of Standards, Department of Commerce, of fire extinguishers heretofore appearing on the approved list, the names of several fire extinguishers have been removed from that list by the Board of Supervising Inspectors.

See page 132 for list of fire extinguishers that may be used until December 31, 1919.

See page 135 for list of fire extinguishers that may be used on and after January 1, 1920. (Sec. 4479, R. S.)

AUTOMATIC FIRE-ALARM SYSTEM.

14. All steamers of more than 150 feet in length under the jurisdiction of the Steamboat-Inspection Service, whose construction is contracted for after June 30, 1916, which are provided with staterooms or other sleeping quarters for passengers, shall be equipped with an efficient fire-alarm system or indicator which will automatically register, at some central point or station where it can be most quickly observed by the officers or crew of the steamer, the presence or indication of fire in the staterooms and various other compartments of the steamer which are not accessible to the observation of the officers or crew. (Sec. 4472, R. S.)

RULE V.—LICENSED OFFICERS.

ORIGINAL LICENSES.

1. Before an original license is issued to any person to act as a master, mate, pilot, or engineer he shall personally appear before the local board or supervising inspector of the district in which he resides or is employed, for examination. Any person who has attained the age of 19 years and has had the necessary experience shall be eligible for examination: *Provided*, That no person shall receive a license as master, mate, first-class pilot, chief engineer, or first assistant engineer before reaching the age of 21 years.

Inspectors shall, before granting an original license to any person to act as an officer of a vessel, require the applicant to make written application upon the blank form furnished by the Department of Commerce, to be filed in the inspector's office. When practicable, applicants for master's, mate's, pilot's, or engineer's license shall present to the inspectors, to be filed with their application, discharges or

letters from the master or other officer under whom they have served, certifying to the name of the vessel and in what capacity the applicant has served under him; also period of such service. Inspectors shall also, when practicable, require applicant for pilot's license to have the written indorsement of the master and engineer of the vessel upon which he has served, and of one licensed pilot, as to his qualifications. In the case of applicants for original engineer's license, they shall also, when practicable, have the indorsement of the master and engineer of a vessel on which they have served, togreater with one other licensed engineer.

The first license issued to any person by a United States inspector shall be considered an original license, where the United States records show no previous issue to such applicant.

No original license shall be issued to any naturalized citizen on less experience in any grade than would have been required of a citizen of the United States by birth. (Sec. 4405, R. S.)

VISUAL EXAMINATIONS REQUIRED FOR ORIGINAL AND RENEWED LICENSES.

2. No original license as master, mate, or pilot of any vessel shall be issued except upon the official certificate of a surgeon of the Public Health Service respecting the vision of the person applying for such original license. The word "original" as contemplated in this section shall mean the first license of any character issued to a master, mate, or pilot, and shall not be held to mean, for instance, that a license issued to a master who was previously licensed as a mate or pilot shall be considered an original master's license.

No license as master, mate, or pilot of any class of vessel shall be renewed except upon the official certificate of a surgeon of the Public Health Service that the color sense of the applicant for renewal is normal.

Where an applicant for renewal of license is situated so that it would put him to great inconvenience or expense to appear before a surgeon of the Public Health Service for examination, the certificate of a reputable physician or oculist as to the color sense of the applicant shall be accepted in lieu of the certificate of the surgeon of the Public Health Service.

In case an applicant for original license or renewal of license is pronounced color-blind he may, in the discretion of the inspectors, be limited to act as master, mate, or pilot on a vessel navigating in daylight only.

Nothing herein contained shall debar an applicant who has lost the sight of one eye from securing a renewal of his license, providing that his color sense is normal. (Secs. 4439, 4440, 4442, R. S.)

EXAMINATIONS.

3. No original master's, mate's, pilot's, or engineer's license shall be issued hereafter or grade increased except upon written examination by a board of local inspectors or a supervising inspector, which written examination shall be placed on file in the office of the inspectors issuing said license: *Provided, however*, That upon navigable waters of the United States newly opened to steamboat navi-

gation, and where the only pilots obtainable are illiterate Indians or other natives, the fact that such persons can neither read nor write shall not be considered a bar to such Indians or other natives receiving license as pilot of steam vessels, provided they are otherwise qualified therefor.

Before granting or renewing a license, inspectors shall satisfy themselves that the applicants can properly hear the bell and whistle signals.

When any person makes application for license it shall be the duty of the local inspectors to give the applicant the required examination as soon as practicable.

If, however, applicants for license can not be examined without material delay by the inspectors of the district in which the applicant resides or is employed, said local inspectors shall endeavor, through the supervising inspector of the district, to arrange for such examination by some other board of local inspectors. (Secs. 4405, 4439, 4440, 4441, 4442, R. S.)

REEXAMINATION AND REFUSAL OF LICENSES.

4. Any applicant for license who has been duly examined and refused may come before the same local board for reexamination at any time thereafter, but he shall not be examined by any other local board until one year has expired from the date of the refusal.

If the inspectors shall decline to grant the applicant the license asked for, they shall furnish him a statement, in writing, setting forth the cause of their refusal to grant the same. (Secs. 4405, 4455, R. S.)

PREPARATION OF LICENSES.

5. All licenses hereafter issued to masters, mates, pilots, and engineers shall be filled out on the face with pen and black ink instead of typewritten. Inspectors are directed, when licenses are completed, to draw a broad pen and black-ink mark through all unused spaces in the body thereof, so as to prevent, as far as possible, illegal interpolation after issue.

Every person receiving license or certificate of lost license shall sign same upon back thereof immediately upon its receipt. (Sec. 4405, R. S.)

CERTIFICATE OF LOST LICENSE.

6. In case of loss of license of any class from any cause, the ininspectors, upon receiving satisfactory evidence of such loss, shall issue a certificate to the owner thereof, which shall have the authority of the lost license for the unexpired term, unless in the meantime the holder thereof shall have the grade of his license raised, after due examination, in which case a license in due form for such grade may be issued. (Sec. 4405, R. S.)

PARTING WITH LICENSE.

7. Any license granted to a master, mate, pilot, engineer, or operator shall be immediately revoked if, for any purpose, the holder thereof voluntarily parts with its possession or places it beyond his

personal control by pledging or depositing it with another. (Sec. 4405, R. S.)

RENEWAL OF LICENSES.

8. Whenever an officer shall apply for a renewal of his license for the same grade, the presentation of the old license, with satisfactory certificate of visual examination where required, and with oath of office, shall be considered sufficient evidence of his title to renewal, which old license, certificate of visual examination, and oath of office shall be retained by the inspectors upon their official files as the evidence upon which the license was renewed: *Provided*, That it is presented within 12 months after the date of its expiration, unless such title has been forfeited or facts shall have come to the knowledge of the inspectors which would render a renewal improper; nor shall any license be renewed more than 30 days in advance of the date of the expiration thereof, unless there are extraordinary circumstances that shall justify a renewal beforehand, in which case the reasons therefor must appear in detail upon the records of the inspectors renewing the license.

Whenever an officer shall apply for renewal of his license for same grade, after 12 months after the date of its expiration, he shall be required to pass an examination for the same grade of license. The renewed license in either case shall receive the next higher number for number of issue of present grade and for number of issues of all grades.

Whenever a licensed officer makes application for a renewal of his license, he shall appear in person before some board of local inspectors or supervising inspector, except that upon renewal of such license for the same grade, when the distance from any local board or supervising inspector is such as to put the person holding the same to great inconvenience and expense to appear in person, he may, upon taking oath of office before any person authorized to administer oaths, and forwarding the same, together with the license to be renewed and certificate of visual examination where required, to the local board or supervising inspector of the district in which he resides or is employed, have the same renewed by the said inspectors, if no valid reason to the contrary be known to them; and they shall attach such oath to the stub end of the license, which is to be retained on file in their office: *Provided*, *however*, That any officer holding a license, and who is engaged in a service which necessitates his continuous absence from the United States, may make application in writing for renewal and transmit the same to the board of local inspectors, with his certificate of citizenship, if naturalized, and a statement of the applicant verified before a consul or other officer of the United States authorized to administer an oath, setting forth the reasons for not appearing in person; and upon receiving the same the board of local inspectors that originally issued such license shall renew the same and shall notify the applicant of such renewal, and no license as master, mate, or pilot of any class of vessel shall be renewed without furnishing a satisfactory certificate of color-blindness. (Secs. 4405, 4438, R. S.)

9. Licensed officers serving under five years' license, entitled by license and service to raise of grade, after passing examination, shall

have issued to them new licenses for the grade for which they are qualified, the local inspectors to file in their office the old license when surrendered, with the report of the circumstances of the case, but the grade of no license shall be raised, except as hereinafter provided, unless the applicant can show one year's actual experience in the capacity for which he has been licensed.

Inspectors shall, before granting an extension of route or raise of grade of license, require the applicant to make his written application upon the blank form of application for extension of route or raise of grade of license furnished by the Department. When practicable, applicants for extension of route or raise of grade of license shall present to the inspectors, to be filed with the application, discharges or letters from the master or other officer under whom they have served, or other satisfactory documentary evidence, certifying to the name of the vessel and in what capacity the applicant has served; also period of such service.

If any board of local inspectors is satisfied by the documentary evidence submitted that a pilot is entitled by experience and knowledge to unlimited tonnage, they may remove any tonnage restrictions which may have been placed upon his license by any other board of local inspectors.

Service on United States lighthouse tenders propelled by machinery shall be considered as equivalent experience for raise of grade as that obtained on vessels subject to inspection by this Service.

Service on United States light vessels propelled by machinery shall be considered as one-half experience for raise of grade as that obtained on vessels subject to inspection by this Service. (Sec. 4405, R. S.)

EXAMINATION FOR RENEWAL OF MASTER'S OR PILOT'S LICENSE.

10. It shall be the duty of all inspectors, before renewing an existing license to a master or pilot of steam vessels, for any waters, who has not been employed as master or pilot on such waters during the three years preceding the application for renewal, to satisfy themselves, by an examination in writing, or orally, to be taken down in writing by the inspectors, that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed. (Secs. 4439, 4442, R. S.)

LAWS, GENERAL RULES AND REGULATIONS, AND PILOT RULES TO BE FURNISHED LICENSED OFFICERS.

11. Every master, mate, pilot, and engineer of vessels shall, when receiving an original license, a renewed license, or a raise of grade of license, be furnished by the inspectors with a copy of the Laws Governing the Steamboat-Inspection Service, and a copy of the General Rules and Regulations Prescribed by the Board of Supervising Inspectors, and every master and pilot of vessels and operator of motor vessels shall, when receiving an original license, a renewed license, or a raise of grade of license, be furnished by the inspectors with a pamphlet copy of the rules and regulations governing pilots and of the statutes upon which such rules are founded, applicable

to the waters on which their licenses are intended to be used, as stated in the body thereof. (Sec. 4405, R. S.)

SUSPENSION AND REVOCATION OF LICENSES.

12. When the license of any master, mate, pilot, or engineer is revoked, such license expires with such revocation, and any license subsequently granted to such person shall be considered in the light of an original license except as to number of issue. And upon the revocation or suspension of the license of any such officer said license shall be surrendered to the local inspectors or supervising inspector ordering such suspension or revocation.

When the license of any master, mate, engineer, or pilot is suspended, the inspectors making such suspension shall determine the term of its duration, except that such suspension shall not extend beyond the time for which the license was issued.

The suspension or revocation of a joint license shall debar the person holding the same from the exercise of any of the privileges therein granted so long as such suspension or revocation shall remain in force. (Sec. 4450, R. S.)

MISCONDUCT OF LICENSED OFFICERS.

13. Whenever a supervising, local, or assistant inspector of steam vessels, or any of them, shall find on board any vessel subject to the provisions of Title LII of the Revised Statutes any licensed officer under the influence of liquor or other stimulant to such an extent as to unfit him for duty, or when any licensed officer shall use abusive or insulting language to any inspector or assaults any such inspector while on official duty, the local inspectors or the supervising inspector shall immediately suspend or revoke the license of the officer so offending without further trial or investigation.

The fact of a licensed officer being under the influence of liquor in the presence of the inspector or inspectors to such an extent as to unfit him for duty while on board a vessel shall be sufficient cause for such suspension or revocation. (Secs. 4405, 4450, R. S.)

LICENSES TO OFFICERS OF VESSELS OWNED BY THE UNITED STATES.

14. Any person who has served at least one year as master, commander, pilot, or engineer of any steam vessel owned and operated by the United States in any service in which a license as master, mate, pilot, or engineer was not required at the time of such service shall be entitled to license as master, mate, pilot, or engineer, if the inspectors, upon written examination, as required for applicants for original license, may find him qualified: *Provided*, That the experience of any such applicant within three years of making application has been such as to qualify him to serve in the capacity for which he makes application to be licensed. (Secs. 4439, 4440, 4441, 4442, R. S.)

REPORTS OF ACCIDENTS TO VESSELS.

15. The licensed officer in command of any vessel subject to the inspection of the Steamboat-Inspection Service shall report in writing and in person to the board of local inspectors nearest the port of

first arrival any accident to said vessel involving loss of life, or damage to property to an approximate amount exceeding $100, and shall also report in the same manner any casualty or loss of life from whatever cause of any person on board such vessel. If the accident happens upon the high seas or without the jurisdiction of inland waters, the board to whom the report is first made shall make the investigation, but if the accident occurs within the jurisdiction of inland waters, the report shall be transmitted to the board within whose jurisdiction the accident occurred, which board shall make the investigation except in cases where, in the judgment of the Supervising Inspector General, better results may be obtained by another board conducting the investigation, in which case the Supervising Inspector General is authorized to direct such investigation by another board: *Provided*, That when from distance it may be inconvenient to report in person it may be done in writing only, and the report sworn to before any person authorized to administer oaths.

Whenever a vessel subject to the inspection of the Steamboat-Inspection Service collides with lightship, buoy, or other aid to navigation under the jurisdiction of the Bureau of Lighthouses, or is connected with any such collision, it shall be the duty of the licensed officer in command of such vessel to report the accident to the nearest board of local inspectors. When any collision of this character is reported to a board of local inspectors, those officers shall immediately transmit such information to the lighthouse inspector of the district in which the collision occurred.

Whenever it appears to the licensed officers of steamers of over 100 gross tons not equipped with wireless telegraphy navigating the Great Lakes that the vessel is in imminent danger of being lost under conditions that there is a possibility of the facts in the case of cause of the loss being unknown, it shall be the duty of the licensed officers in charge to cause to be prepared a report stating the cause of the loss of the vessel and giving the facts connected therewith as fully as possible; also a list of the officers and crew, the same to be inclosed in a message case or receptacle to be carried for that purpose, in order that the facts in connection with the loss of the vessel may eventually become known to the officers of this Service. (Secs. 4405, 4448, R. S.)

ONLY CERTAIN PERSONS ALLOWED IN PILOT HOUSE AND ON NAVIGATOR'S BRIDGE.

16. Masters and pilots of steamers carrying passengers shall exclude from the pilot houses and navigator's bridge of such steamers, while under way, all persons not connected with the navigation of such steamers, except officers of the Steamboat-Inspection Service, Coast Guard, and engineer officers of the United States Army in charge of the improvement of that particular waterway, when upon business: *Provided*, That licensed officers of steamboats, persons regularly engaged in learning the profession of pilot, officers of the United States Navy, United States Coast and Geodetic Survey, and Lighthouse Service, assistant engineers of the Engineer Department of the United States Army connected with the improvement of that particular waterway, and the engineer officers connected with the

construction and operation of the Panama Canal may be allowed in the pilot house or upon the navigator's bridge upon the responsibility of the officer in charge.

The master of every such passenger and ferry steamer shall keep three printed copies of this section of Rule V posted in conspicuous places on such steamer, one of which shall be kept posted in the pilot house.

Such printed copies shall be furnished by the Department of Commerce to local inspectors for distribution. (Sec. 4405, R. S.)

STATION BILLS, DRILLS, AND REPORTS OF MASTERS.

17. It shall be the duty of the officer in charge of every steamer carrying passengers to cause to be prepared a station bill for his own department, and one also for the engineer's department, in which shall be assigned a post or station of duty for every person employed on board such steamer in case of fire or other disaster, which station bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week, to call all hands to quarters and exercise them in the discipline and in the unlashing and swinging out of the lifeboats, weather permitting, and in the use of the fire pumps and all other apparatus for the safety of life on board of such vessel, with especial regard for the drill of the crew in the method of adjusting life preservers and educating passengers and others in this procedure and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log book, stating the day of the month and hour when so exercised; and it shall be the duty of the inspectors to require the officers and crew of all such vessels to perform the aforesaid drills and discipline in the presence of the said inspectors at intervals sufficiently frequent to assure the said inspectors by actual observation that the foregoing requirements of this section are complied with; the master shall also report monthly to the local inspectors the day and date of such exercise and drill, the condition of the vessel and her equipment, and also the number of passengers carried, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce this rule shall be deemed cause for the suspension or revocation of the license of such officer.

The *general* fire-alarm signal shall be a continuous rapid ringing of the ship's bell for a period of not less than 20 seconds, and this signal shall not be nsed for any other purpose whatsoever. The master of any steamer carrying passengers may establish such other emergency signals in addition to the ringing of the ship's bell as will provide that all the officers and all the crew of the steamer will have positive and certain notice of the existing emergency.

Three copies of this section shall be furnished every steamer carrying passengers, to be framed under glass and posted in conspicuous places about the vessel. (Sec. 4405, R. S.)

STEAM VESSELS REQUIRING LICENSED MASTERS.

18. There shall be a duly licensed master on board every steam vessel of more than 150 gross tons, subject to the inspection laws of the United States, whenever such steamer is under way. (Secs. 4439, 4463, R. S.)

MASTER OF STEAM VESSELS.

19. Any applicant for license as master of steam vessels shall be eligible for examination after he has furnished satisfactory documentary evidence to the local inspectors that he has had the following experience:

First. At least one year's experience as first-class pilot or chief mate of steam vessels.

Second. Or five years' combined experience in the deck department of sail vessels and vessels propelled by machinery, one year of which has been as pilot or chief mate.

Third. Or one year's experience as master of steam vessels of 150 gross tons or under while acting under the authority of a first-class pilot's license, or two years' experience while acting under the authority of a second-class pilot's license.

Fourth. Or five years' experience on sail vessels, one year of which has been as master.

Fifth. Or three years' experience as master of sail vessels on the Great Lakes, for license as master of steam vessels on the Great Lakes and other inland waters.

Sixth. Or three years' experience as master of barge consorts on the Great Lakes, and has been licensed as first-class pilot for one year, for license as master of steam vessels on the Great Lakes.

Any applicant for license as master of steam vessels shall be subjected to such examination as shall satisfy the local inspectors that he is capable of navigating such steam vessels. (Sec. 4439, R. S.)

MASTER OF FERRY STEAM VESSELS.

20. Any applicant for license as master of ferry steam vessels shall be eligible for examination after he has furnished satisfactory documentary evidence to the local inspectors that he has had the following experience:

First. One year's experience as first-class pilot.

Second. Or two years' experience as wheelsman or quartermaster while holding a first-class pilot's license.

Third. Or two years' experience in charge of a steam vessel of 150 gross tons or under while acting under the authority of a pilot's license.

Any applicant for license as master of ferry steam vessels shall be subjected to such examination as shall satisfy the inspectors that he is capable of navigating such vessels. (Sec. 4439, R. S.)

MASTER OF PASSENGER BARGES.

21. Any person applying for license as master of barges carrying passengers shall have had three years' experience in the deck department of such vessels and shall be subjected to such examination as

will show his ability to handle the class of vessels for which he desires a license. (Sec. 4438, R. S.)

MATE OF INLAND STEAMERS.

22. Whenever any person presents himself for examination for license as mate of inland steamers, the local inspectors shall examine him as to his knowledge, experience, and skill in loading cargo and in handling and stowage of freight, his knowledge of the operation and handling of fire apparatus, the launching and handling of lifeboats, his knowledge of life preservers and the method of adjusting them, his ability to manage the crew and direct and advise the passengers in case of emergency, and his general familiarity with his duties in maintaining discipline and protecting the passengers, and if found qualified they shall grant him a license as such, but no such license shall be granted to any person who has not had at least two years' experience in the deck department of a steam vessel. (Sec. 4440, R. S.)

DUTIES OF MATES OF INLAND STEAMERS.

23. It shall be the duty of the mate of every inland steamer carrying passengers to assign to deck or steerage passengers the space they may occupy on board during the voyage, and to supervise the stowage of freight or cargo, and see that the space set apart for passengers is not encroached upon. He shall also carefully examine all marks on packages of freight delivered on board for shipment, with a view to detect and prevent any combustible or other dangerous articles prohibited by law being delivered on board. Three copies of this section shall be furnished every steamer to which this section applies, to be framed under glass and posted in conspicuous places about the steamer, one of which shall be on the main deck. (Secs. 4405, 4440, R. S.)

INDORSEMENT OF MASTER'S OR MATE'S LICENSE AS PILOT.

24. Whenever a master or mate desires to act in the double capacity of master and pilot, or mate and pilot, and furnishes the necessary documentary evidence of his qualifications, the local inspectors shall indorse such pilot routes on the certificate of license after the required written examination. (Sec. 4443, R. S.)

EXPERIENCE REQUIRED FOR LICENSE AS PILOT.

25. No original license for pilot of any class shall be issued to any person, except for special license for steamers of 10 gross tons and under, who has not served at least three years in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort, one year of which experience must have been obtained within the three years next preceding the date of application for license, which fact the inspectors shall require, when practicable, to be verified by the certificate, in writing, of the licensed master or pilot under whom the applicant has served, such certificate to be filed with the application of the candidate: *Provided*, That one year's experience as quarter-

master or wheelsman while holding a second-class pilot license shall entitle the holder of such license to examination for license as first-class pilot.

Special pilots may be licensed for steamers of 10 gross tons and under, locally employed.

The local inspectors shall, before granting a license as pilot, satisfy themselves that the applicant is qualified to steer. (Sec. 4442, R. S.)

EXTENSION OF PILOT'S ROUTE.

26. Whenever any pilot applies to a board of local inspectors for an extension of his pilot's route, he shall make written application, on form furnished by department, stating the extension desired, and he shall be examined, in writing, on the aids to navigation on said extension, and if found qualified, shall receive such extension. (Secs. 4405, 4442, R. S.)

TONNAGE OF STEAM VESSELS ON WHICH PILOTS MAY ACT.

27. The navigation of every steamer above 150 gross tons shall be under the control of a first-class pilot, and every such pilot shall be limited in his license to the particular service for which he is adapted.

A first-class pilot or a second-class pilot who has reached the age of 21 years may act as master or pilot in charge of the navigation of a steamer not exceeding 150 gross tons. A second-class pilot is authorized to act as pilot in charge of a watch on any steamer within the tonnage specified in his license. (Sec. 4442, R. S.)

PILOTS GOVERNED BY RULES.

28. Pilots of steam vessels, while in the discharge of their duties, shall be governed by the rules of the Board of Supervising Inspectors, made for their guidance, and not by any instructions emanating from any inspector or other person. (Secs. 4405, 4442, R. S.)

LICENSE OF OWNER AS MASTER OR PILOT OF STEAM YACHT.

29. Whenever the owner of steam or sailing yachts, who has reached the age of 21 years and has had three years' experience on board such yachts, applies for a license to act as pilot or master of lake, bay, or sound steam yachts, the local inspectors shall give the applicant a written examination in regard to his knowledge in handling such vessels, and his familiarity with the lights, lighthouses, channels, buoys, obstructions, courses, and distances between certain points in the waters for which he makes application for license, and shall also examine him as to his knowledge of the pilot rules of such waters, the running and anchor lights, fog signals, the use of the lead, signal bells between engine room and pilot house, and the general rules and regulations for steam vessels. If the local inspectors are satisfied, after such examination, of the applicant's ability, they shall issue the applicant a license as pilot or master of steam yachts for the waters over which they are authorized to issue licenses. (Secs. 4439, 4442, R. S.)

QUALIFICATIONS REQUIRED FOR LICENSE AS ENGINEER OF STEAM VESSELS, AND LICENSE FORMS REQUIRED.

30. No person shall receive an original license as engineer or assistant engineer of steam vessels (except for license as engineer of sawmill boats and pile drivers propelled by steam, and except for special license as engineer of a steam vessel of any kind of 10 gross tons or under on which a licensed engineer is required) who has not served at least 36 months in the engineer's department of a steam vessel, a portion of which experience shall have been obtained within the three years next preceding the application: *Provided*, That any person who has served three years as apprentice to the machinist trade in a marine, stationary, or locomotive engine works, and any person who has served for a period of not less than three years as a locomotive or stationary engineer, and any person graduated as a mechanical engineer from a duly recognized school of technology may be licensed to serve as an engineer of steam vessels after having had not less than one year's experience in the engine department of steam vessels, a portion of which experience shall have been obtained within the three years preceding his application, which fact shall be verified by the certificate, in writing, of the licensed engineer and master under whom the applicant has served, said certificate to be filed with the application of the candidate: and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, distance from center of valve to fulcrum, weight of lever, and weight of valve and stem being known) to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, such knowledge to be determined by an examination in writing, and the report of examination filed with the application in the office of the local inspectors, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications. No original license shall be granted any engineer or assistant engineer who can not read and write and does not understand the plain rules of arithmetic.

No person holding a special engineer's license, Form 878, shall be eligible for examination for a higher grade of license until such person has actually served two full seasons under the authority of his license and one additional full season in a subordinate capacity upon steamers requiring regularly licensed officers.

All licenses to engineers of steam vessels of 10 gross tons and under shall be issued on Form 876, special license to engineers of steam vessels of 10 gross tons and under, and all other licenses to engineers of steam vessels shall be issued on Forms 876 (chief engineer's license) and 877 (assistant engineer's license), according to grade of chief and assistant engineer, as specified.

Inspectors may designate upon the certificate of any chief or assistant engineer the tonnage of the vessel on which he may act.

Wherever the word "year" appears in the following paragraphs of this rule, it shall be understood as contemplating 12 months. (Sec. 4441, R. S.)

CLASSIFICATION OF ENGINEERS.

CHIEF.

31. Chief engineer of condensing lake, bay, and sound steamers.

Chief engineer of noncondensing lake, bay, and sound steamers.

Any person holding chief engineer's license shall be permitted to act as first assistant engineer on any steamer of double the tonnage of same class named in said chief's license.

Engineers of all classifications may be allowed to pursue their profession upon all waters of the United States in the class for which they are licensed. (Sec. 4441, R. S.)

FIRST ASSISTANT.

32. First assistant engineer of condensing lake, bay, and sound steamers.

First assistant engineer of noncondensing lake, bay, and sound steamers.

Engineers of lake, bay, and sound steamers who have actually performed the duties of engineer for a period of three years shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument; and shall be granted such grade as the inspectors having jurisdiction on the Great Lakes and seaboard may find him competent to fill.

Any first assistant engineer of steamers of 1,000 gross tons and over, having had actual service in that position for one year, may, after satisfactory written examination, be licensed as chief engineer of lake, bay, sound, or river steamers of 1,000 gross tons or under, which license shall be indorsed with authority to act as first assistant engineer of steamers of any tonnage for which he is qualified.

Any person holding a license as first assistant engineer, and having had experience as first assistant engineer for a portion of the year (the year being assumed to be 12 months) required for raise of grade, may substitute experience as second assistant engineer, while holding first assistant engineer's license, which experience as second assistant engineer shall only count as one-half: *Provided*, That any person having had a first assistant engineer's license for two years, and having had two years' experience as second assistant engineer, shall be eligible for examination for chief engineer's license. (Sec. 4441, R. S.)

SECOND ASSISTANT.

33. Second assistant engineer of condensing lake, bay, and sound steamers.

Second assistant engineer of noncondensing lake, bay, and sound steamers.

Any person holding a license as second assistant engineer, and having had experience as second assistant engineer for a portion of the year required for raise of grade, may substitute experience as

third assistant engineer, while holding second assistant engineer's license, which experience as third assistant engineer shall only count as one-half: *Provided*, That any person having had a second assistant engineer's license for two years, and having had two years' experience as third assistant engineer, shall be eligible for examination for first assistant engineer's license. (Sec. 4441, R. S.)

THIRD ASSISTANT.

34. Third assistant engineer of condensing lake, bay, and sound steamers.

Any person holding a license as third assistant engineer and having had 12 months' experience as junior engineer, or 12 months' combined service as third assistant engineer and junior engineer, or two years' experience as oiler or water tender, or two years' combined service as oiler and water tender, since receiving said license, shall be eligible for examination for license as second assistant engineer. (Sec. 4441, R. S.)

ENGINEERS OF MOTOR VESSELS.

35. No person shall receive an original license as engineer of vessels of above 15 gross tons, propelled by gas, fluid, naphtha, or electric motors, carrying freight or passengers for hire, who has not served at least one year on motor boats or in the engineers' department of steam vessels, or who has not had at least two years' experience in the construction of marine motor engines and their installation. All examinations for license as engineer of motor vessels shall be reduced to writing and filed with the application of the candidate.

Any person holding a license as engineer of steam vessels desiring to act as engineer of motor vessels must appear before a board of local inspectors for examination as to his knowledge of the machinery of such motor vessels, and if found qualified shall be licensed as engineer of motor vessels. (Sec. 4426, R. S.)

EXAMINATION OF BOILERS AND MACHINERY BY ENGINEER.

36. It shall be the duty of an engineer when he assumes charge of the boilers and machinery of a steamer to forthwith thoroughly examine the same, and if he finds any part thereof in bad condition, caused by neglect or inattention on the part of his predecessor, he shall immediately report the facts to the master, owner, or agent, and to the local inspectors of the district, who shall thereupon investigate the matter, and if the former engineer has been culpably derelict of his duty they shall suspend or revoke his license. (Sec. 4441, R. S.)

REPORTS OF ACCIDENTS, REPAIRS, AND UNSAFE BOILERS AND MACHINERY BY ENGINEERS.

37. Before making general repairs to a boiler or a steam vessel the engineer in charge of such steamer shall report, in writing, the nature of such repairs to the local inspector of the district wherein such repairs are to be made.

And it shall be the duty of all engineers when an accident occurs to the boilers or machinery in their charge tending to render the further use of such boilers or machinery unsafe until repairs are made, or when, by reason of ordinary wear, such boilers or machinery have become unsafe, to report the same to the local inspectors immediately upon the arrival of the vessel at the first port reached subsequent to the accident or after the discovery of such unsafe condition by said engineer. (Sec. 4441, R. S.)

Rule VI.—Inspection of Vessels.

1. The annual inspection of any vessel subject to the provisions of Title LII, Revised Statutes of the United States, shall be made only on written application, presented to the United States local inspectors by the owner, master, or authorized agent of the vessel to be inspected. Such application shall state upon its face that previous application for inspection has not been made to any other board of local inspectors or supervising inspector. (Sec. 4417, R. S.)

2. Steam vessels employed by the Government, unless the titles of the same are actually vested in the United States, are not exempt from inspection. (Sec. 4400, R. S.)

3. Inspectors may lawfully inspect within their respective districts, upon proper application, any vessel running upon the waters of their district the certificate of which is about to expire. (Sec. 4417, R. S.)

4. In the inspection of hulls of vessels, the inspector of hulls shall carefully inspect every accessible part of the hull, and carefully examine the wood or metal of which the hull is constructed, to determine the condition of same, making all necessary hammer tests of hulls constructed of iron or steel. If the inspector shall not have satisfactory evidence otherwise of the soundness of the hull of a wooden vessel, he shall not give a certificate until the same shall be bored or opened up to his satisfaction. (Secs. 4405, 4417, R. S.)

5. Whenever any vessel is placed upon the dock for repairs it shall be the duty of the master, owner, or agent to report the same to the board of local inspectors of that district, so that a thorough inspection may by them be made to determine what is necessary to make such vessel seaworthy if the condition or age of the vessel, in the judgment of the inspectors, renders such examination necessary.

No repairs or alterations affecting the safety of the vessel, either in regard to hull or machinery, shall be made without the knowledge of the local inspectors. Notice of such repairs and changes is necessary, even if such work does not require the vessel to be placed in a dry dock, and even if there are no licensed officers attached to the vessel. (Sec. 4417, R. S.)

6. Certificates of inspection signed by one local inspector only shall not be valid, nor shall the name of a regular inspector be substituted by that of any other person upon any such certificate. This rule also applies to licenses. (Sec. 4421, R. S.)

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing the revocation or suspension of certificates of inspection, in case such process is authorized by law.

Local inspectors issuing a permit to any vessel to proceed to other ports for repairs shall state upon the face of the same the conditions upon which it is granted and whether the vessel is to be allowed to carry freight or passengers, the quantity and number: *Provided, however*, That no vessel whose certificate had *expired* shall be permitted to carry passengers or freight while en route to another port for repairs.

When, under section 4456, Revised Statutes of the United States, vessels obtain a permit from the local inspectors of a district to go from their district to another to make repairs, said local inspectors shall notify the supervising inspector of their district, stating the repairs to be made on said vessels. The supervising inspector shall notify the supervising inspector of the district where such repairs are to be made, furnishing him a copy of the report of the inspectors indicating the repairs ordered on said vessels. (Secs. 4421, 4453, 4456, R. S.)

8. On and after July 1, 1911, the owner of every new vessel of over 100 gross tons, when making application for first inspection of the vessel, shall furnish the local inspectors of the district where the vessel is to be inspected drawings or blue prints, in plan and section, showing fully the general construction of the vessel, of wood, iron, or steel, including dimensions, spacing of frames, disposition of hull plates, outside and in, or of outside and inside planks, construction of decks, construction of transverse and longitudinal bulkheads and location of same, space between decks, and details of principal scarfs, and shall also furnish a statement of the shapes, dimensions, and unit weights of all structural parts of the hull and of the kinds of material of which made, including kinds of wood. A full description of the riveting of all parts of an iron or steel hull shall be furnished.

The drawings or blue prints and description of the vessel shall be retained in the office of the local inspectors making the first inspection of the vessel. (Secs. 4405, 4417, R. S.)

9. In the inspection of hulls, boilers, and machinery of vessels, the rules promulgated by the American Bureau of Shipping respecting material and construction of hulls, boilers, and machinery, and the certificate of classification referring thereto, except where otherwise provided for by these rules and regulations, shall be accepted as standard by the inspectors of this service. (Secs. 4405, 4417, R. S.)

10. A copy of all blue prints and (or) specifications of all articles approved after March 28, 1919, for use on steam vessels shall be supplied to each supervising inspector.

RULE VII.—FERRYBOATS.

1. The navigation of ferryboats shall be confined to the ferry routes specified in the certificate of inspection; but such vessels may be permitted to go beyond their authorized routes with passengers only, or, without such permit, to lighten or relieve vessels in distress, When any ferryboat leaves her ferry route and carries passengers, she shall be required to carry the same officers, crew, and equipment as required of other steamers carrying passengers. (Sec. 4426, R. S.)

2. All ferryboats of more than 75 gross tons carrying passengers for hire, whose construction is commenced after March 31, 1913, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if any compartment is flooded. (Sec. 4426, R. S.)

3. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life rafts, outside ladders, and other means of escape, in case of disaster, as, in the opinion of the inspectors, shall meet the requirements of each particular case. But in no case shall the cubic feet of boat capacity be less than that provided in the table following:

	Cubic feet.
Ferryboats of 50 and not over 300 gross tons	120
Ferryboats over 300 and not over 600 gross tons	240
Ferryboats over 600 gross tons	360

Provided, That on ferryboats of more than 300 gross tons one-half the boat capacity required may be substituted by its equivalent in approved life rafts.

Ferryboats of less than 50 gross tons shall be equipped with boats or rafts as in the opinion of the inspectors may be necessary in case of disaster to secure the safety of all persons on board. (Sec. 4426, R. S.)

4. All ferryboats shall be equipped with a life preserver for each person carried, and in addition thereto shall have a number of life preservers suitable for children equal to at least 10 per cent of the total number of persons carried. All life preservers shall be distributed in the most accessible places, where they can be reached at all times.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage. (Sec. 4426, R. S.)

5. All car-ferry steamers transporting passengers in cars shall carry the same life-saving and fire-fighting equipment as required on ferryboats, excepting that the number of life preservers shall equal the number of persons carried. (Sec. 4426, R. S.)

6. It shall be the duty of the master of any such car-ferry steamer to see that all of the doors of the cars are unlocked and that the vestibules of the cars are open while the cars are on the steamer, to allow the persons so carried free egress at all times. (Sec. 4426, R. S.)

Rule VIII.—Excursion Steamers.

1. If the master, agent, or owner of any passenger or ferry steamer desires a permit to engage in excursions, the inspectors, upon the written application of such a master, agent, or owner, may issue the same, stating the number of extra passengers the boat may carry with safety, the route she may run, and the kind and extra number of life-saving appliances with which she is provided. The permit, when used, shall be framed under glass and exposed to the view of the passengers, in connection with the certificate of inspection.

Increases in the passenger allowance of any vessel, whether specified in regular certificate or by excursion permit, may be allowed only after personal inspection of the vessel by the local inspectors, or by the supervising inspector if he grants the increase, who must be satisfied that the vessel and her equipment justify the additional allowance, and of which inspection a written record shall be made and kept in the files of the office granting the allowance and a copy thereof forwarded to the office of the Supervising Inspector General. (Sec. 4466, R. S.)

2. Passenger steamers making excursions shall have, in addition to their regular life-saving equipments, a life preserver made in accordance with the rules of the board, or their equivalent in other approved life-saving appliances, for each additional passenger allowed. (Sec. 4466, R. S.)

Rule IX.—Barges.

1. Any open or uncovered barge carrying passengers while in tow of any steamer shall carry 1 life preserver or 1 float for every person carried, 6 fire buckets, 2 axes, and a yawl boat or boats of a capacity in the same proportion to the number of persons carried as is required for lifeboats on steamers carrying passengers. (Sec. 4492, R. S.)

2. Covered barges or barges with inclosed deck or decks shall carry the same equipment as required by the preceding section, except that they shall carry 12 fire buckets and 3 axes. (Sec. 4492, R. S.)

3. Every barge carrying passengers in tow of any steamer and engaged in excursions shall be supplied with 1 life preserver or 1 float for every person carried on board, and shall be equipped with

10 fire buckets, 3 axes, and 2 yawl boats of not less than 60 cubic feet capacity each, to be carried on deck ready to be launched for immediate use, or towed in such manner as to best afford prompt relief in case of accident or disaster. (Sec. 4492, R. S.)

4. Any barge in tow of a steamer and used for transporting passengers in cars shall be equipped in accordance with this rule, and the master or person in charge of the barge or the master of the towing steamer shall see that all of the doors of the cars are unlocked and that the vestibules of the cars are open while the cars are on the barge, to allow the persons so carried free egress at all times. (See 4492, R. S.)

5. The fire buckets referred to in this rule shall be of metal, kept in an appropriate rack or frame, or suspended from overhead hooks within easy reach. They shall be kept filled with water and ready for use at all times, and shall be fitted with a rope lanyard of a length not less than twice the distance from the lower deck of the barge to the water. (Sec. 4492, R. S.)

6. All open barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high. (Sec. 4492, R. S.)

Rule X.—Duties of Inspectors.

1. No supervising inspector shall make his annual report public until after the same has been printed and made public by the department; and, further, no local board, or the clerk thereof, shall make public any report without the consent of their supervising inspector or that of the Supervising Inspector General. (Sec. 4410, R. S.)

2. It shall be the duty of the supervising inspectors to inform their respective local boards, in writing, of their decisions in cases of appeal. Supervising inspectors granting license to a vessel engaged in towing to carry persons in addition to its crew, under the act approved February 23, 1901, shall notify the local inspectors in whose

jurisdiction the steamer receiving the permit is engaged, and the local inspectors shall keep a record of the same.

It shall be the duty of local inspectors to notify the local inspectors of adjoining districts, through the supervising inspector, of all revocations or suspensions of licenses, and also of the names of all persons from whom licenses have been withheld, the names of all steam vessels neglecting or refusing to make repairs when ordered, and the names of all that have been refused certificates, with the reasons therefor. (Secs. 4411, 4427, R. S.)

3. Whenever any inspector shall find it necessary, in conducting his investigations or in the performance of any of his duties, to obtain testimony from the inspectors of other districts, he shall request the same through the supervising inspector. (Sec. 4405, R. S.)

4. Inspectors, at their annual inspections of steam boilers, may cause to be removed from the surface of such boilers as are covered so much of said covering as may be necessary to enable them to examine parts of the boilers which can not be properly examined from the inside, and shall examine in a thorough and careful manner, when practicable, either externally or internally, all parts of the shell of every boiler; and the masters, engineers, and owners of every steam vessel shall afford every facility necessary to carry out in the most effective and efficient manner the provisions of this section, and in no case shall an intermediate inspection be deemed any part of the regular annual inspection. (Secs. 4405, 4418, R. S.)

5. It shall be the duty of inspectors when inspecting or reinspecting a vessel to carefully examine all steam pipes passing through woodwork, and if in their judgment the same are deemed unsafe they shall have them provided with air space and fitted with metal collars. (Secs. 4405, 4418, R. S.)

6. It shall be the duty of the inspector who inspects the boilers of any steamer to actually enter the boiler or boilers where it is possible to do so, and to thoroughly examine the interior of all such boilers to see that the braces are in place and of proper size, and to determine whether the boilers are in good condition, before granting a certificate of inspection, such examinations to be made after the hydrostatic pressure has been applied. A record shall be made in the boiler inspector's report of inspection showing whether or not the inspector did actually enter the boiler, and if he did not enter the boiler, he shall give his reasons for not entering it. (Secs. 4405, 4418, R. S.)

7. It shall also be the duty of the inspectors to compel all floating structures, such as steam elevators (propelled by their own motive power), to have their whistles located on the front side of such superstructures having an elevation higher than the pilot house of the vessels. (Sec. 4405, R. S.)

8. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of same below its top, when not hinged for passing under bridges, except upon steamers navigating the Red River of the North, Yukon and similar rivers, and rivers whose waters flow into the Gulf of Mexico, and steamers of less than 100 gross tons, whose steam whistles shall be placed not less than 2 feet above the tops of their pilot houses; and all double-end ferry

steamers, and steamers similarly constructed, shall have a steam whistle both fore and aft of the smokestack, or one steam whistle on either the starboard or port side of the smokestack, so that the steam, when whistle is blown, can be seen from either end of steamer, and it shall be the duty of inspectors to enforce this rule at the annual inspection. (Sec. 4405, R. S.)

9. It shall be the duty of both the hull and boiler inspectors to be present when the boiler is being tested by hydrostatic pressure, and the hull inspector, as well as the boiler inspector, shall observe and note the indication upon the gauge.

It shall also be the duty of both the hull and boiler inspectors to examine all pumps, hose, and other fire apparatus and to see that the hose is subjected to a pressure of 100 pounds to the square inch, and that the hose couplings are securely fastened in accordance with these rules.

It shall be the duty of the local inspectors to require all passenger or freight steamers of 1,500 gross tons and upward, navigating the Great Lakes, except paddle-wheel steamers, to be equipped with an efficient mechanical deep-sea sounding apparatus, or an efficient shallow-water alarm, in addition to the ordinary deep-sea hand lead. The mechanical deep-sea sounding apparatus or efficient shallow-water alarm, above required shall be installed, kept in working order, and ready for immediate use. (Secs. 4405, 4417, 4418, R. S.)

10. Local boards shall report forthwith to their supervising inspectors in detail all accidents of a serious character—such as collisions, founderings, sinkings, fires—and all other casualties of interest to or affecting the steamboat service in their respective districts. (Sec. 4405, R. S.)

11. Local inspectors shall report, for each fiscal year, as soon as practicable after the end of each fiscal year, to their supervising inspectors, all vessels inspected, arranged according to class and grade; all examinations into alleged violations of the laws regulating vessels, and the action taken in relation to the same: all investigations and decisions by local inspectors; all cases of appeal and the result thereof; casualties and investigations of same: the names of all persons licensed; the names of all whose licenses have been suspended or revoked; the names of all persons from whom licenses have been withheld; and shall render all other annual reports required by the regulations of the department. These reports, together with any other annual reports that may be submitted by supervising and local inspectors, shall be forwarded by supervising inspectors to the Supervising Inspector General. (Secs. 4410, 4411, R. S.)

12. When it is known or comes to the knowledge of the local inspectors that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the United States district attorney for prosecution under section 4437, Revised Statutes of the United States, shall require the owner or owners of said steamer to place on the boiler of said steamer a lockup safety valve that will prevent the carrying of an excess of steam and shall be under the control of said local inspectors.

On the placing of a lockup safety valve upon any boiler, it shall be the duty of the engineer in charge of same to blow or cause the said

valve to blow off steam at least once in each watch of six hours or less, to determine whether the valve is in working order, and it shall be the duty of the master of such vessel to see that this rule is observed, and it shall be the duty of the master and engineer to report to the local inspectors any failure of such valve to operate.

In case no such report is made, and a safety valve is found that has been tampered with or out of order, the license of the engineer having such boiler in charge and the license of the master of such vessel shall be suspended or revoked.

It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the department. (Secs. 4418, 4437, R. S.)

13. All official records and official documents on file in the office of any supervising inspector or board of local inspectors, after official action thereon has been concluded, may be open to public inspection and examination: *Provided*, That such inspection or examination be made in the office to which such official records and documents belong. (Sec. 4405, R. S.)

14. It shall be the duty of the inspectors when inspecting or reinspecting a vessel to see that all exposed and dangerous places, such as gears and machinery, are properly protected with covers, guards or rails, in order that the danger of accidents may be minimized. (Secs. 4405, 4417, R. S.)

15. When inspectors have any reason to question the stability of any vessel under their jurisdiction, they shall require the owners of the vessel to make inclining tests on such vessel, under the supervision of expert naval architects provided by the Department of Commerce. (Sec. 4405, R. S.)

16. It shall be the duty of the inspectors when inspecting or reinspecting vessels to carefully examine all air ports and deadlights in the hull, and to satisfy themselves that the same are safe. (Secs. 4405, 4417, R. S.)

17. It shall be the duty of the inspectors when inspecting or reinspecting vessels to carefully examine the lifeboat disengaging apparatus and the blocks and falls thereof and to satisfy themselves that the same are in good condition. (Secs. 4405, 4417, R. S.)

Rule XI.—Miscellaneous.

1. Steamers using the bell signals between the pilot house and engine room shall have a tube, of proper size, so arranged as to return the sound of the bell signals to the pilot house, and shall also be provided with a speaking tube or other device for the purpose of conversation between pilot house and engine room.

Nothing in the above shall be construed to prevent the use of the so-called telegraph now in use for conveying signals from the pilot house to the engine room, but in all cases where the telegraph is used the signal shall be repeated back.

On all steamers where the distance is more than 150 feet between deck houses, a wire cable shall be stretched between the deck houses at all times when the vessel is loaded and being navigated, this cable to be not less than 5 feet from the deck; and there shall be attached at all times to the cable a traveler with a line of sufficient continuous length to insure its operation, in order that communication between both ends of the vessel may be facilitated at all times: *Provided*, That a number of iron rings with suitable lanyards attached, equaling in number the total number of persons carried, may be attached to the cable in lieu of the traveler and endless whip, and that suitable manila lines of sufficient length shall be kept dry and coiled at each end of the vessel ready for immediate use in order that communication between both ends of the vessel may be facilitated at all times. Failure to have such cable stretched and traveler, or rings with lanyards, attached at all times when the vessel is loaded and being navigated shall be sufficient cause for the suspension of the license of the master or officer in charge.

On all steamers where the distance is more than 150 feet between perpendiculars of pilot house and forward part of the engine room there shall be communication by means of a telephone between the pilot house and engine room, such telephone to be installed in lieu of a speaking tube.

Steamers navigating the waters of the Great Lakes, so constructed as having deck houses on the main or spar deck and exposed to the sea, shall be provided with storm shutters for the windows, and where

the doors of such deck houses are not constructed of steel or iron plate, or of wood having a thickness of not less than 2 inches, the doors shall be provided with storm doors or shutters: *Provided*, That where the boiler house is located on the main or spar deck and exposed to the sea an avenue of escape shall be provided from the boiler house to the engine room or through the top of the boiler house with the necessary ladders and scuttle, thereby enabling the boiler-house doors to be kept closed during heavy weather. (Secs. 4405, 4417, R. S.)

2. Motor vessels of any tonnage other than steam vessels shall be provided with a whistle to be blown by compressed air or other power, to give the necessary whistle signals to passing vessels. (Sec. 4405, R. S.)

3. All steam vessels of over 100 gross tons shall have all sleeping accommodations equipped with an alarm bell unless there is a watchman always on duty in such apartment or the apartment is so situated and arranged that the inspectors consider such bell unnecessary or dangerous. Where electric bells are installed they shall be operated by a switch from the pilot house or bridge. (Sec. 4405, R. S.)

4. None of the inflammable articles specified in section 4472, Revised Statutes, or oil that will not stand a fire test of 300° F. shall be used as stores on any pleasure steamer or steamer carrying passengers, except that vessels not carrying passengers for hire may transport gasoline or any of the products of petroleum for use as a source of motive power for the motor boats or launches of such vessels. (Sec. 4472, R. S.)

5. Refined petroleum which will not ignite at a temperature of less than 110° F. may, upon routes where there is no other practicable mode of transporting it, be carried on passenger steamers; but it shall not be lawful to receive on board or transport any petroleum unless the owner or master of the steamer shall have first received from the inspectors a permit designating the place or places on such steamer in which the same may be carried or stowed, with the further condition that the permit shall be conspicuously posted on the steamer.

Refined petroleum shall not in any case be received on board or carried unless it is put up in good iron-bound casks or barrels or in good metallic cans or vessels, carefully packed in boxes, and the casks, barrels, or boxes plainly marked on the heads thereof with the shipper's name, the name of the article, and the degree of temperature (Fahrenheit) at which the petroleum will ignite.

Lubricating oils shall be stored in secure tanks, casks, or cans in the engine-room compartments or storeroom, or in metal-lined lamp lockers or oil rooms. Kerosene or other illuminating oils meeting the requirements of the law shall be stored in metallic tanks or cans, and carried in the oil rooms or lamp lockers constructed in accordance with the General Rules and Regulations. (Sec. 4472, R. S.)

6. Vessels carrying passengers or freight for hire permitted under the authority of the act of Congress approved October 22, 1914, amending section 4472, Revised Statutes of the United States, to transport and use gasoline or any of the products of petroleum for the operation of engines to supply an auxiliary lighting and wireless system independent of the vessel's main power plant, shall be allowed

to carry not to exceed 40 gallons of gasoline or any of the products of petroleum for such purposes when contained in a seamless or lapwelded steel tank, cylindrical in form, not less than one-fourth (0.25) of an inch thick, and of a capacity of at least 10 per cent more than the volume of the contents. The tank shall be tinned on the inside and tested to 300 pounds pressure to insure tightness, and fitted with a vent pipe of ample capacity, with no angles in pipe greater than 45°, opening to the atmosphere at a point not less than 10 feet above the highest house, the vent pipe to end with a U bend with the opening protected by wire gauze. The filling pipe or cap shall be entirely independent of other connections. The tank shall be carried on the highest deck of the steamer and so located that there may be a free circulation of air all around it.

Steamers engaged in transoceanic service or on voyages of more than 10 days' duration in either direction may carry such quantities of gasoline or any of the produets of petroleum as may be necessary to supply an auxiliary service already installed, the tanks already installed and the location of same being allowed for this purpose. On steamers where the auxiliaries are maintained by engines using the heavy oils, the oil may be carried in quantities not to exceed 15 tons, when contained in iron or steel tanks of sufficient strength to withstand the action of sea or temperature, and so located as to be properly insulated or ventilated if either is necessary.

All tanks shall be firmly and properly secured to prevent being torn away from beds or saddles by heavy weather or excessive list of the ship, and shall be the object of daily inspection by the officers of the ship intrusted with their eare.

There shall be placed within 5 feet of every tank containing gasoline, benzine, or naphtha not less than two fire extinguishers of approved type which have demonstrated a capacity for extinguishing burning gasoline, which fire extinguishers shall be in addition to the fire extinguishers already required. (Sec. 4472, R. S.)

7. The fuel-oil tanks on all inland steamers subject to the rules and regulations of the Steamboat-Inspection Service shall be constructed of material of such thickness and workmanship as, in the judgment of the inspector in whose district the installation is made, is safe.

Application for permission to use petroleum as fuel shall be made in duplicate to the supervising inspector of the district in which the vessel is at the time she is equipped to use oil as fuel. Application to use petroleum as fuel shall be made on the blanks furnished for that purpose. Two blue prints or tracings showing the proposed installation of the tanks, pumps, piping, valves, and burners shall accompany the application.

On all vessels of over 500 gross tons using oil as fuel there shall be in each fireroom a metal tank containing 50 gallons of sand, fitted with a scoop or shaker, for fire purposes; also two or more approved fire extinguishers placed accessible to the fireroom and ready for immediate use: *Provided, however*, That steamers of 500 gross tons and under using oil as fuel may be fitted with metal tanks containing 25 gallons of sand, and one approved fire extinguisher.

Provided, further, That the fire extinguishing agency known as foamite may be used on vessels using oil for fuel, when such foamite

and the apparatus for distributing same in the fire hold are installed in accordance with drawings or blue prints and specifications approved by the Board of Supervising Inspectors.

There shall be fitted to the settling tank, or any tank which is a source of supply to the pumps feeding the burners, an internal gate valve operated by an extension rod leading to an accessible point, in an open space on a deck, outside the engine and fire-room casing, so that the flow of oil may be immediately shut off in case of the failure or rupture of any of the pipes or connections. Sec. 4474, R. S.)

8. All passenger steamers navigating lakes, bays, and sounds in the nighttime shall have a watchman on each deck below the hurricane deck, including the cabins, such as are accessible to the passengers and crew when underway.

All watchmen shall be under the direct charge of the master or officer in command of the vessel, and each shall report to the officer in command at the pilot house at fixed intervals of not longer than every hour. (Sec. 4477, R. S.)

9. All passenger and ferry steamers shall, in addition to the regular pilot on watch, have one of the crew also on watch in or near the pilot house; and this rule applies to all steamers navigating in the nighttime. (Sec. 4405, R. S.)

10. *Starting, stopping, and backing signals for steam vessels navigating the waters of the eighth and ninth supervising inspection districts.*

The eighth district embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

The ninth district embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, Champlain, and their tributaries.

There shall be used between the master or pilot and engineer the following code of signals, to be made by bell or whistle, namely:

1 whistle or 1 bell	Go ahead.
1 whistle or 1 bell	Stop.
2 whistles or 2 bells	Back.
3 whistles or 3 bells	Check.
4 whistles or 4 bells	Strong.
4 whistles or 4 bells	All right.

Two whistles or two bells shall always mean back, irrespective of other signals previously given. (Sec. 4405, R. S.)

11. Any master or pilot of any steam vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. (Sec. 4405, R. S.)

12. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside and constructed of bronze or brass or other material equal thereto in tone and volume of sound, and located where the sound shall be the least obstructed. (Sec. 4405, R. S.)

13. Unnecessary sounding of the steam whistle is prohibited within any harbor limits of the United States. Whenever any licensed officer in charge of any steamer authorizes or permits such unnecessary whistling, upon conviction thereof before any board of inspectors having jurisdiction, such officer shall be suspended from

acting under his license as the inspectors trying the case may deem proper. (Sec. 4405, R. S.)

14. Any master or pilot of any steam vessel who shall authorize or permit the carrying of any light, electric or otherwise, not required by law, on the outside structure of the cabin or hull of the vessel that in any way will interfere with distinguishing the signal lights shall, upon conviction thereof before any board of inspectors having jurisdiction, be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. (Secs. 4405, 4450, R. S.)

15. On and after July 1, 1920, all steamers of the United States subject to the regulations of this Service, engaged in the passenger service, which are electrically lighted by dynamos located below the deep-load line of the vessel shall have on board an auxiliary lighting system located above the deep-load line to light the steamer sufficiently to enable passengers and crew to find their way to the exits, which auxiliary lighting system shall be ready for use in case of failure of the main lighting plant and to be so installed and arranged that all auxiliary lights may be switched on from a central station. Where such auxiliary lights are served by storage batteries, arrangements shall be such that the auxiliary lights and alarm bells will be put in service separately or together by one operation from the pilot house or navigator's bridge: *Provided, however*, That where oil lamps are used as auxiliary lights, such oil lamps shall be kept lighted between the hours of sunset and sunrise while such vessels to which this section applies are being navigated, or while passengers are on board: *Provided further*, That cabin watchmen and cabin patrols on duty in the nighttime on all vessels with staterooms to which this section applies shall have in their possession while on such patrol duty a suitable and efficient dry-battery flash light. (Sec. 4472, R. S.)

16. It shall be the duty of the master of any vessel under the jurisdiction of the Steamboat-Inspection Service, and which is carrying cargo, to assure himself before leaving port that all the cargo hatches of his vessel are properly covered and the covers secured. The covers of all exposed cargo hatches shall be made water-tight by fitting to pliable gaskets, or by being thoroughly covered with hatch cloths or tarpaulins firmly secured by iron or steel bars extending from side to side or end to end of hatchway, which bars shall be fastened by toggles or wedges of hardwood or by efficient screw fastenings. Wooden hatch bars of sufficient size or strength already installed and maintained in good condition may be accepted in lieu of the iron or steel bars above referred to: *Provided*, That steamers having 6 feet or more of freeboard, measured vertically from the water's edge at the lowest point of sheer to the top of deck at the ship's side, shall not be required to use the hatch cloths or tarpaulins between March 31 and August 31. This exemption, however, does not relieve the master of any responsibility for the security and protection of his hatches during the interval of exemption, and in case of indications of bad weather or other threatening conditions, he shall not leave port until the hatches are properly covered, secured, and protected. Failure by the master of any vessel to observe this regulation shall be sufficient cause for suspension of his license on a charge of inattention to his duty. (Sec. 4405, R. S.)

17. On all vessels under the jurisdiction of the Steamboat-Inspection Service, the entire steering gear, the whistle, the means of communication, and the signaling appliances between the bridge or pilot house and engine room shall be examined and tested by a licensed officer of the vessel at least once in every week and an official record kept of the fact and time of such examination and test.

18. On all vessels contracted for after June 30, 1916, using electricity for lighting, the installation shall be in keeping with the best modern practices.

Wires shall be run in approved iron conduits, armored casing, or molding.

Iron conduit or armored casing shall be required in bunkers, cargo spaces, storerooms, etc., and in all places where the leads are liable to mechanical injury. Joints in wiring shall be avoided as far as possible in the above-named spaces. Where wires are led through beams, frames, or nonwater-tight bulkheads, they shall be carried either in iron conduits, armored casing, or protected by hard rubber, or other equivalent bushings.

Where wires are carried through water-tight decks or bulkheads, they shall be provided with a suitable stuffing box at deck or bulkhead. Where such points are liable to mechanical injury they shall be protected by suitable boxes or cages.

In locating the wiring system as a whole, care shall be taken to provide accessibility for examination and repair. Special care shall be taken to avoid any arrangement which might permit the lodgment of standing water.

All taps, joints, and splices shall be fitted with water-tight junction boxes.

Joints shall be so spliced or the parts so joined as to be both mechanically and electrically secure without solder. They shall then be soldered and properly insulated and further protected by waterproof tape.

Changes or alterations in the electrical installations of vessels now in service shall be in accordance with this rule.

Special attention shall be given by the inspectors in the examination of present installation to see that it is of such nature as to preclude any danger of fire, giving particular attention to wiring which is carried through wooden bulkheads, partitions, etc. (Secs. 4405, 4417, R. S.)

19. Steamers more than 150 feet in length under the jurisdiction of the Steamboat-Inspection Service carrying passengers or passengers and freight and contracted for after June 30, 1916, shall have the funnel or funnels protected by an iron or steel trunk or casing extending through and past all decks above their connection with the boiler or breeching. If the engine-room compartment extends above the main deck it shall be protected through all decks by surrounding iron or steel bulkheads and by an iron or steel trunk extending through and past the upper deck.

20. On and after December 31, 1916, all steamers carrying passengers, and which also carry freight upon the main deck which is accessible to passengers or crew while being navigated, shall have installed in such main-deck freight space an efficient overhead water-sprinkling system.

The crew and passenger sleeping accommodations located below the main deck on steamers engaged in the passenger traffic shall have installed therein an efficient overhead water-sprinkling system, unless such quarters and the bed frames therein are constructed of metallic or noncombustible material, thereby making them practically fireproof.

On steamers carrying passengers where the kitchens or galleys are located below the main deck, there shall be installed in such kitchens or galleys an efficient overhead water-sprinkling system. This paragraph shall become effective July 1, 1917.

The water-sprinkling system above referred to shall be reliable and efficient and so located that the volume of discharge shall be sufficient to entirely cover or blanket the freight in case of fire, and to entirely and fully sprinkle the compartment in which the passengers or crew may be accommodated below deck, and be installed in such manner as to be easily and quickly accessible of operation, and shall be ready for service at all times when freight or passengers are on board. (Secs. 4405, 4417, 4472, R. S.)

21. It shall be the duty of the master and chief engineer of any vessel under the jurisdiction of the Steamboat-Inspection Service to see that such vessel and the passenger and crew's quarters are kept in a sanitary condition. Failure on the part of the master (or chief engineer so far as it applies to the engineers' department) of any vessel to observe and carry into effect this section shall be sufficient cause for the suspension of his license on a charge of inattention to his duties. (Secs. 4405, 4417, R. S.)

RULES OF PRACTICE FOR THE GOVERNMENT OF SUPERVISING AND LOCAL INSPECTORS OF STEAM VESSELS IN TRIALS OF LICENSED OFFICERS OF VESSELS.

I. Suspension and Revocation of Licenses.

1. The inspectors shall, when the charges have been duly filed against a licensed officer of vessel, furnish the accused with a copy thereof, setting forth specifically their character and the section of the statutes or the rules of the board that have been violated.

2. Subpœnas shall be in the prescribed form, one copy of which shall be furnished each witness.

3. All testimony shall be reduced to writing. The accused shall be permitted to cross-examine witnesses, and in case of exceptions to questions for any cause the inspectors shall note the exceptions in the margin of the deposition. The deposition shall be sworn to before an officer authorized to administer oaths.

4. The accused may have the hearing of the case continued upon the presentation of reasons satisfactory to the board, and the board may, in like manner, continue the hearing from day to day.

5. During the trial the witnesses shall be examined separately, but if the accused is also a witness he shall not be subject to this rule.

6. At any time before the conclusion of the evidence the charge or charges, if being tried on charges, may be amended, notice of said amendment being furnished to the accused of the nature of such amendment, but no amendment shall be permitted after the conclusion of the evidence.

7. Where the witnesses reside in a district other than that in which the accused is being tried, a certified copy of the charges, together with such interrogatories as the inspectors desire to propound, may be forwarded to the inspectors of the district where the witnesses reside, and said inspectors shall examine the witnesses in the same manner as prescribed in section 3 of this rule.

8. The testimony thus taken shall be forwarded to the inspectors investigating the case and read as evidence in the cause, the same as though such testimony had been taken by the inspectors trying the same.

9. The inspectors shall furnish the accused with a statement in writing of their finding in the premises.

10. No copy of testimony or other matter obtained in any investigation held by any board of local inspectors shall be given out, but a copy of testimony taken at a trial by any board of local inspectors shall be given to the accused or his representative when request for same is made. (Secs. 4448, 4449, 4450, R. S.)

II. Appeal to Supervising Inspectors.

1. The supervising inspector, upon notice of an appeal from the decision of the local board, provided said notice of appeal shall be made within 30 days from the date of the decision of the local board, shall give notice in writing to said local board to forward a certified copy of their decision, together with the charges and all evidence in writing on file in their office.

2. The supervising inspector shall then proceed to investigate the case under the same rules prescribed for the trial of the accused by the local board.

3. The testimony taken before the local board may be considered by the supervising inspector for the purpose of determining whether the finding of the local board is justified by the evidence, and he shall have power to remand the same for explanation or correction.

4. Upon the conclusion of the case the supervising inspector shall furnish the appellant with a notice of his finding in like manner as prescribed for local inspectors. (Sec. 4452, R. S.)

INSTRUMENTS, MACHINES, AND EQUIPMENTS APPROVED FOR USE ON VESSELS.

[Year in which approved is given in parenthesis.]

LIFEBOATS.

Aniello lifeboat. (1895.)

P. R. Beaupré, Metropolis, Ill., automatic self-righting and bailing lifeboat. (1872.)

Burke, Wise & Co.'s lifeboat lowering and launching apparatus. (1878.)

Baswitz lifeboat, Gustav H. Schwab, New York, N. Y. (1897.)

Brude lifeboat, Konrad Furubotn, Seattle, Wash. (1913.)

Coston 28-foot collapsible lifeboat, approved as a lifeboat of class 2A, and allowed 52 persons; Coston Supply Co., New York, N. Y. (1918.)

Dickinson's self-righting lifeboat. (1881.)

Dean & Co.'s improved diagonal lifeboat. (1883.)

Dobbin's lifeboat. (1885.)

Dobbin's metallic lifeboat. (1888.)

Thomas Drein & Sons, Wilmington, Del., corrugated metallic lifeboat, when fitted with suitable bottom boards of usual form to prevent the bulging of the floor plates by falling timbers. (1900.)

J. Walter Douglas lifeboat. (1893.)

Eddy's patent sea lifeboat. (1883.)

Engelhardt collapsible lifeboat, The Engelhardt Collapsible Lifeboat Co., Long Island City, N. Y. (1904.)

Emergency Fleet Corporation's standard metallic lifeboats 16, 24, and 26 feet in length, and equipments for same. (August, 1918.)

Emergency Fleet Corporation's standard metallic lifeboats 20 and 28 feet in length, and standard metallic motor lifeboat 26 feet in length. (October, 1918.)

Gaskin reversible lifeboat, Wm. H. Appleton, New York, N. Y. (1918). Rated as second class 2A, and life raft. (1919.)

Hoy semidecked motor lifeboat, M. P. Hoy, Tacoma, Wash. (1916.)

Hercules patent noncanvas collapsible lifeboat, presented by James Howden & Co. (Ltd.), New York, N. Y. (1918.)

Hills nesting type of lifeboat, H. B. Hills, of Steward Davit & Equipment Corporation, New York, N. Y. Two 26-foot lifeboats of this type may be nested under a single set of davits. (1919.)

O. R. Ingersoll, self-righting and self-bailing lifeboat. (1887.)

International Automatic Lifeboat Co., Chicago, Ill., and Portland, Me. Metallic lifeboat. (1911.)

George Judson's lifeboat. (1878.)

Lundin decked lifeboat, Welin Davit and Lane & De Groot Co., Long Island City, N. Y. (1912.) See Rule III. (Improvements,

subject to approval of supervising inspector of district in which the boat is constructed. 1915.)

Lundin housed lifeboat, Welin Marine Equipment Co., Long Island City, N. Y. (1914.) See Rule III.

Lundin open lifeboat with balsa-wood fenders, Welin Marine Equipment Co., Long Island City, N. Y. (1914.) See Rule III.

Lundin power lifeboat, Welin Marine Equipment Co., Long Island City, N. Y. (1914.) See Rule III.

Lundin semidecked lifeboat, Welin Marine Equipment Co., Long Island City, N. Y. (1915.) See Rule III.

Lundin lifeboats of semidecked housed type, presented by Welin Marine Equipment Co., Long Island City, N. Y. (1918.)

Mayo Rescue lifeboat, R. D. Mayo, Muskegon, Mich. (1901.)

Mayo Junior lifeboat, Robert D. Mayo, jr., Hopkins Station, Mich. (1904.)

Loring W. Myer's lifeboat, Lubec, Me. (1905.)

Charles R. McCotter's lifeboat, Jacksonville, Fla. (1914.) See Rule III.

F. L. Norton's lifeboat: boats to be built of yellow metal. (1887.)

W. J. Numan's lifeboat, Buffalo, N. Y. (1897.)

A. D. Newcomb, Richmond, Va., inclosed lifeboat. (1917.)

Richardson's self-righting and self-bailing lifeboat. (1884.)

Mr. Stoddars's self-righting and self-bailing lifeboat. (1872.)

Shear's self-righting and self-bailing boat. (1873.)

S. O. S. lifeboat, Holmes Motor Co. (Inc.), West Mystic, Conn. (1915.)

William H. Taylor's lifeboat, Narragansett Pier, R. I. (1894.)

LIFEBOAT DISENGAGING APPARATUS.

Patent quick boat-releasing hook, presented by Harry A. Attfield, Berkeley, Calif. (1917.)

Boat automatic releasing device, presented by Bouchard & Killian, Milwaukee, Wis. (1909.)

Broady boat-releasing gear, presented by Welin Marine Equipment Co., Long Island City, N. Y. (1918.)

Coston boat-releasing gear, Coston Signal Co. (Inc.), New York, N. Y. (1911.)

Coston positive boat-releasing gear, presented by Coston Supply Co., New York, N. Y. (1918.)

Corser's one-man simultaneous releasing lifeboat hook, Pacific Boat & Iron Works, Portland, Oreg. (1918.)

Coulter lifeboat releasing hook, C. J. Coulter, Long Beach, Calif. (1919.)

Duinkers boat-releasing device, Royal Dutch West India Mail, New York, N. Y. (1909.)

Gaertner boat-releasing hook, R. A. Gaertner, Seattle, Wash. (1911.)

Hunt automatic boat-releasing device, Charles Hunt, New York, N. Y. (1909.)

Boat-detaching apparatus, Charles Hunt, Washington, D. C. (1913.)

J. J. Haviside, jr., San Francisco, Calif. Boat-releasing hook. (1911.)

William J. Huff, Toronto, Canada. Boat-releasing hook. (1912.)

Hills boat-releasing gear, New York Shipbuilding Co., Camden, N. J. (1917.)

Interisland disengaging boat hook, presented by Capt. A. Tullett, Honolulu, Hawaii; approved for use only in Hawaiian waters. (1909.)

Irwin lifeboat disengaging hook, presented by Irwin Manufacturing Co., San Francisco, Calif. (1914.)

Jacques boat-releasing appliance, Damase Jacques, Detroit, Mich. (1913.)

Klippert lifeboat-disengaging apparatus, Eckliff Circulator Co., Detroit, Mich. (1919.)

Mills patent boat-disengaging gear, presented by William Mills Co. (Ltd.), Sunderland, England. (1906.)

Murray boat-disengaging apparatus, A. Luckhurst, New York, N. Y. (1909.)

Boat-releasing device, John A. McNabb, New York, N. Y. (1918.)

New England Navigation Co.'s standard boat-disengaging gear. (1906.)

Porter instantaneous engaging and disengaging device, C. M. Lane Lifeboat Co., Brooklyn, N. Y. (1917.)

Raymond boat-releasing apparatus, presented by James R. Raymond, New York, N. Y. (1906.) Rule adopted August, 1918: On and after November 1, 1918, all Raymond lifeboat releasing hooks shall be arranged with a continuous fall so as to insure the coincident lowering of the forward and after ends of the boat, the releasing gear to be attached to the boat with fittings appropriate for the Raymond gear. This rule shall apply to all Raymond hooks installed after August 12, 1918.

Boat-detaching device, presented by Henry E. Rottmer, Washington, D. C., approved only when installed with the lever fitted so as to be conveniently operated by the officer of the boat. (1906.)

Randle patent boat-disengaging apparatus, presented by the New York Shipbuilding Co., Camden, N. J. (1907.)

Semple & Ward boat-disengaging apparatus, presented by Capt. Allen Luckhurst, International Navigation Co., New York, N. Y. (1907.)

Boat-detaching hook, presented by Charles E. Wicks, Norfolk, Va (1909.)

Windon boat-releasing gear, Monarch Valve Co., Brooklyn, N. Y. (1916.)

Young's lifeboat-releasing device, presented by Kinney Bros., Buffalo, N. Y. (1909.)

The Yankee boat-disengaging apparatus, Owen J. McGowan, president, Raymond Releasing Device (Inc.), New York, N. Y. (1919.)

WHISTLES FOR MOTOR VESSELS.

Electro-corno whistle, presented by The Elkhart Dry Battery & Signal Co., Elkhart, Ind. (1910.)

Ever Ready electric horn, for use on motor boats, the American Ever Ready Co., New York, N. Y. (1911.)

Holtzer-Cabot electric horn, The Holtzer-Cabot Electric Co., Brookline, Mass. (1909.)

Jones electric horn, presented by Joseph W. Jones, New York, N. Y. (1910.) Any other like device equally efficient is allowed for use.

Klaxon warning signals, electric and hand actuated, for use on motor vessels, presented by Miller R. Hutchinson, New York, N. Y. (1909.) Any other device equally efficient also allowed for use.

Mesco electric horn, presented by the Manhattan Electrical Supply Co., New York, N. Y. (1911.)

Sireno warning signal, presented by The Sireno Co., New York, N. Y. (1911.)

LIFE RAFTS.

A B C life raft (balsa wood), Welin Marine Equipment Co., Long Island City, N. Y. (1917.) See Rule III.

American Flexible Life Raft Co. (1877.)

Ammen metallic balsa or life raft. (1895.)

Anderson & Bailey, San Francisco, Calif. (1910.)

Angelus life raft, William Jacob, San Leandro, Calif. Equivalent to a pontoon life raft of the standard type. (1919.)

M. A. Bryson's deer-hair life raft. (1877.)

Beasley's life raft. (1881.)

Hon. H. C. Calkin's (New York) metallic raft. (1872.)

Clark's life raft, care Detroit Shipbuilding Co., Detroit, Mich. (1873, 1910.)

J. A. Cone. (1875.)

J. A. Cone's life raft (Drein & Son), Wilmington, Del. (1886.)

Columbia life raft, Churchman & Groves, Philadelphia, Pa. (1886.)

Chamber's life raft. (1888.)

Carley life float, Carley Life Float Co., M. T. Whiton, president. (1901.) See Rule III.

Court life float, types A and B, A. B. Court, naval constructor, U. S. N. (1918.)

Cambridge life float, presented by The T. J. Flynn Metal Works (Inc.), Cambridge, Mass. (1918.) See Rule III.

Davis's life raft. (1877.)

Emergency Fleet Corporation's standard metallic pontoon life rafts, and equipments for same, for 12, 17, and 24 persons. (August, 1918.)

Frazee Life Raft Co., New York, metallic raft. (1872.)

Griffith life raft. (1890.)

Gaskin reversible life raft, Wm. H. Appleton, New York, N. Y. (1918.)

Gaskin reversible lifeboat rated as life raft, Wm. H. Appleton, New York, N. Y. (1919.)

Edwin A. Hay's life raft. (1883.)

Emmett Harding's combined life raft and settee, when cylinders are constructed of metal. (1884.)

Hussey life raft. (1894.)

O. R. Ingersoll, New York, metallic raft. (1872.)

O. R. Ingersoll's life raft, canvass cylinders covered with rattan, when provided with cross braces and air-tight valves for determining its air-tight condition. (1884.)

O. R. Ingersoll's life raft composed of two cylinders made of cane and filled with block cork. (1887.)

David Kahnweiler's metallic life raft, New York, N. Y. (1888.)
Le Duc Tule Improvement Co.'s life raft, San Francisco, Calif. (1886.)
Lane & De Groot, Brooklyn, N. Y., metallic life raft. (1898.)
Matson life raft, H. J. Matson, Boston, Mass. (1909.)
Miller's life-saving raft. (1881.)
Moran Bros. Co., Seattle, Wash., metallic life raft. (1906.)
J. J. McLaughlin's life raft, Bombay, India. (1918.)
Ogden's life raft. (1874.)
Rider's life raft. (1877.)
Robert Roberts's metallic raft. (1884.)
Lewis H. Raymond's life raft. (1881.)
L. H. Raymond, the Reliance metallic life raft, New York, N. Y. (1896.)
W. S. Ray Manufacturing Co., San Francisco, Calif., metallic life raft. (1906.)
John T. Smith's metallic life raft, when the cylinders are provided with water-tight bulkheads placed not over 2 feet apart. (1884.)
John T. Smith's life raft, when constructed of galvanized iron of not less than 24 wire gauge, Birmingham standard, in thickness. (1885.)
Sweeney life float, presented by the Herreshoff Manufacturing Co., Bristol, R. I. (1918.) See Rule III.
Torrey & Co. (1872.)
Twigg life raft, presented by John F. Twigg, San Francisco, Calif. Standard pontoon type of raft. (1919.)
Woolsey's life buoy. Rated for two persons, for lake, bay, and river, when made, as at present, of 52 pounds of cork, and in that proportion when containing a greater amount of cork. (1881–1883.)
F. H. Ward's metallic folding life raft. (1897.)
Welin Davit and Lane & De Groot Co., New York, N. Y. Metallic life raft. (1911.)

LIFE PRESERVERS.

Armstrong Bros. & Co., Pittsburgh, Pa., compressed granulated cork life preserver. (1885.)
Armstrong Cork Co., Pittsburgh, Pa., child's cork life preserver. (1916.)
A B C life belt (balsa wood), presented by the Lane & De Groot Co., New York, N. Y. (1909.)
A B C life preserver (balsa wood), presented by the Welin Davit and Lane & De Groot Co., Long Island City, N. Y. (1912.)
Atlantic-Pacific Manufacturing Co., Brooklyn, N. Y. Cork-block body with kapok collar. Kapok body with kapok collar. (1919.)
Bryson's deer-hair life preserver. (1877.)
H. Brunswig, life-saving buoy, Hoboken, N. J. (1898.)
Butz block-cork life preserver, A. L. Butz Cork Co., Philadelphia, Pa. (1905.)
Boddy No. 4 life-saving jacket (kapok), presented by Boddy Life-Saving Appliances (1914), Ltd., London, England. (1918.)
Miss Anna Deane Bailey, New York, N. Y.; improved life preserver No. 1, of the jacket and collar type, filled with 28 ounces of prime Java kapok; two types of the Bailey adjustable and reversible

kapok life preservers for adults and children, one with brass grommets, and one with eyelets for strap leaders. (1918.)

E. Clark, cork life preserver. (1872.)

George Clark, jr., life preserver. (1878.)

Eliza R. Cogswell, life preserver, invented by. (1883.)

Compressed Cork Co., Ossining, N. Y., cork body with kapok collar. (1920.)

Clara V. Czepull, Lancaster, Pa., block-cork life preserver. (1915.)

Coston improved life belt (combination cork and kapok), presented by Coston Supply Co., New York, N. Y. (1918.)

James S. Dunant's California tule life preserver. (1884.)

Godfrey & Boyce's life preserver. (1875.)

W. K. Greenebaum, Chicago, Ill., block-cork life preserver, adjustable, for adult or child. (1916.)

C. C. Galbraith & Son (Inc.), New York, N. Y., cork-block body with kapok collar. (1919.) Child's life preserver, cork body and kapok collar. (1920.)

J. B. Hamilton's life preserver, Springfield, Mass. (1901.)

Dr. Charles Hunt's life preserver, New York, N. Y. (1907.)

George W. Hendry, San Francisco, Calif., tule life preserver, adjustable, for adult or child. (1916.)

O. R. Ingersoll, cork life preserver. (1872.)

International tule life preserver, one kind for adults and one kind for children, presented by Haviside, Withers & Davis, San Francisco, Calif. (1917.)

Kahnweiler's Neversink life preserver. (1874.)

D. Kahnweiler & Son's pressed-cork life preserver. (1894.)

David Kahnweiler's Sons, New York, N. Y. Kahnweiler's Neversink cork life jacket with kapok collar. Cork-block body with kapok collar. (1919.) Child's life preserver, cork body and kapok collar. (1920.)

Kapo Neversink life preserver, Charles Garrison, Boston, Mass. (1917.)

Kapo Manufacturing Co., Boston, Mass., life jacket and commercial life preserver, kapok. (1918.)

Knickerbocker Supply Co., New York, N. Y., kapok jacket life preserver. (1918.)

Le Duc Tule Improvement Co.'s life preserver. (1886.)

C. M. Lane, of the Lane & De Groot Co., Long Island City, N. Y., the Ravenswood life preserver. (1904.)

Joseph K. McCammon, the Le Duc. (1887.)

Morrison Life Belt Co., St. Louis, Mo., cork life preserver. (1904.)

G. H. Masten Co. (Inc.), New York, N. Y., kapok life-preserver jacket. (1918.) Bailey cork life-preserver jacket with kapok collar, Bailey kapok life-preserver jacket with combination kapok collar and hood, cork-block body with kapok collar, kapok body with kapok collar, Masten's cork life preserver, Masten's kapok life preserver. (1919.)

L. Mundet & Son, Brooklyn, N. Y., cork-block body with kapok collar, kapok body with kapok collar. (1919.)

National Cork Co., life preserver, Brooklyn, N. Y. (1904.)

Fitch Reynold's cork life preserver. (1879.)

Robinson & Roders Co., Newark, N. J., universal ilanasilk ship life preserver, adjustable, for adult or child. (1916; modified, 1918.) Universal ilanasilk pillow life preserver, adjustable, for adult or child. (1916.) Universal ilanasilk patrol life preserver. (June, 1916; modified, 1918.) Universal ilanasilk jacket life preserver. (1917, 1918; modified and approved for adults and children, 1918.) Edmonds's A B C balsa-wood life jacket, with ilanasilk collar, for adult and for child; Edmonds's cork life jacket with ilanasilk collar; Edmonds's life jacket with kapok body and kapok collar for adult, same for child; Edmonds's life jacket with balsa-wood body and kapok collar for adults, same for child. (1919.)

J. A. Seamans, cork life preserver. (1872.)

M. A. Scott, cork life preserver. (1872.)

John T. Smith's life preserver, New York. (1892.)

The Edward Maynard life preserver, presented by John T. Smith, New York. (1887.)

Sanitary Java kapok life-preserver vest, presented by the Everfloat Life Preserver Co., New York, N. Y. (1918.)

Safety-At-Sea Corporation, New York, N. Y., Dreadnaught life preserver made of prime Java kapok. (1919.) Modified Dreadnaught life preserver made of kapok. (1920.)

United Indurated Fibre Co., Lockport, N. Y. (1908.)

Upson-Walton Co., solid-cork life preservers, Cleveland, Ohio. (1905.)

White & Hay's cork life jacket. (1878.)

LIFE BUOYS.

A B C ring life buoy (balsa wood), presented by Welin Marine Equipment Co., Long Island City, N. Y. (1916.) See Rule III.

Indestructible ring life buoys (cork), types A and B, presented by George Bernard Dame, Brooklyn, N. Y. (1918.)

Universal ilanasilk ring life buoy, presented by Robinson-Roders Co., Newark, N. J. (1917.)

LINE-CARRYING GUNS AND PROJECTILES.

American & British Manufacturing Co., Bridgeport, Conn.

Coston line-carrying gun, Coston Signal Co., New York, N. Y. (1913.)

Coston Supply Co., New York, N. Y. Shoulder gun. (1919.)

Driggs Ordnance Co. (Inc.), New York, N. Y. Sayres line-carrying gun. (1919.)

C. D. Durkee & Co., New York, N. Y. (1919.)

C. C. Galbraith & Son, New York, N. Y. (1919.)

The General Ordnance Co., Groton, Conn. (1919.)

E. George & Co. (Inc.), New York, N. Y. (1919.)

Hall line-carrying gun, presented by The Naval Co., Philadelphia, Pa. (1919.)

Hunt's line-carrying gun, large. (1890.)

Hunt's line-carrying gun, small. May be used on all vessels from 100 to 500 tons. (1890.)

Hunt gun, No. 2, 20 inches long, 2½ inches diameter of bore. May be used on steam vessels from 100 to 500 tons when the gun is con-

structed in all its parts of material same as used in the large Hunt gun already approved by this board. (1893.)

International line-carrying gun No. 3, George Murch, New York, N. Y. (1909.)

David Kahnweiler's Sons, New York, N. Y. (1915.)

Knickerbocker Supply Co., New York, N. Y. (1919.)

Lyle line-carrying gun. (1890.)

Lyle life-saving shoulder gun may be used on all vessels not exceeding 300 gross tons. (1906.)

Gun and self-anchoring projectile carrying a life line, presented by Meyer & Rogers, Seattle, Wash. (1907.)

Meyer-Rogers line-carrying gun No. 2, Meyer-Rogers Projectile Co., New York, N. Y. (1909.)

Equipment for the Meyer-Rogers line-carrying guns Nos. 1 and 2, Meyer-Rogers Projectile Co., New York, N. Y. (1909.)

Marine Manufacturing & Supply Co., New York, N. Y. (1919.)

McNab Co., Bridgeport, Conn. (1919.)

The Naval Co., Philadelphia, Pa. Models A and B. (1919.)

R. S. Newbold & Sons Co., Norristown, Pa. (1919.)

Wm. Read & Sons (Inc.), Boston, Mass. Shoulder gun. (1919.)

Semple line shot tracer, presented by John B. Semple, Pittsburgh, Pa. (1907.)

A. P. Smith Manufacturing Co., East Orange, N. J. (1919.)

Steward Davit & Equipment Corporation, New York, N. Y. Two types. (1919.)

The Tozzi Manufacturing Co., New York, N. Y. (1919.)

United States Life-Saving Equipment Co., Boston, Mass. Illuminated double line-carrying shot. (1911.)

The James Walker Co., Baltimore, Md. (1919.)

FIRE EXTINGUISHERS.

LIQUID CHEMICAL FIRE EXTINGUISHERS APPROVED FOR USE ON VESSELS ON AND AFTER JANUARY 1, 1920.

Aaron, Robinson Fire Apparatus Manufacturing Co., St. Louis, Mo.

Accurate, National Metal Stamping Manufacturing Co., Newark, N. J.

Alert, American-La France Fire Engine Co., Elmira, N. Y.

Apex, Minimax Co., New York, N. Y. (1920.)

Badger, Badger Fire Extinguisher Co., Boston, Mass.

Badger's No. 1 (1 quart, carbon tetrachloride), Badger Fire Extinguisher Co., Boston, Mass.

Bear, American-La France Fire Engine Co., Elmira, N. Y.

Buscoba, American-La France Fire Engine Co., Elmira, N. Y.

Cascade, James Boyd & Bro. (Inc.), Philadelphia, Pa.

Chief Croker, Croker National Fire Prevention Engineering Co., New York, N. Y.

Childs, O. J. Childs Co., Utica, N. Y.

Childs Model A (1 quart, carbon tetrachloride), O. J. Childs Co., Utica, N. Y.

Columbia, Columbia Fire Extinguisher Co., New York, N. Y.

Crescent, John Simmons Co., New York, N. Y.

Eastman, American Fire Apparatus Co., New York, N. Y.

Ecnarusni, Buffalo Chemical Fire Extinguisher Co., Buffalo, N. Y.

Fairbanks, The Fairbanks Co., Philadelphia, Pa.

Fire Gun No. 1 (1 quart, carbon tetrachloride), Fire Gun Manufacturing Co. (Inc.), New York, N. Y.

Guardene, Pyrene Manufacturing Co., New York, N. Y.

Guardene pump tank, 5 gallons capacity, accepted in lieu of the 2½-gallon fire extinguisher; Pyrene Manufacturing Co., New York, N. Y.

Hale, American-La France Fire Engine Co., Elmira, N. Y.

Hayward, S. F. Hayward & Co., New York, N. Y.

Hickory, Kelley-How Thomson Co., Duluth, Minn.

Jennison, Jennison Hardware Co., Bay City, Mich.

Josico, John Simmons Co., New York, N. Y.

Kar-bo-lene (2 quarts, carbon tetrachloride), A. C. Rowe & Son, New York, N. Y.

Keystone, James Boyd & Bro., Philadelphia, Pa.

La France No. 3 (1 quart, carbon tetrachloride), American-La France Fire Engine Co. (Inc.), Elmira, N. Y.

La Prudentia, S. F. Hayward & Co., New York, N. Y.

Lonisville, American-La France Fire Engine Co., Elmira, N. Y.

Magician, Washington Rubber Co., Washington, D. C.

Metropolitan, Metropolitan Fire Extinguisher Co., New York, N. Y.

Metropolitan No. 2, Metropolitan Fire Extinguisher Co., New York, N. Y.

Type S Copper Minimax, 1½ and 2½ gallons, Minimax Co., New York, N. Y.

One Quart (1 quart, carbon tetrachloride), American-La France Fire Engine Co. (Inc.), Elmira, N. Y.

Paragon, James Boyd & Bro., Philadelphia, Pa.

Patrol, American-La France Fire Engine Co., Elmira, N. Y.

Peerless, American-La France Fire Engine Co., Elmira, N. Y.

Presto (1 quart, carbon tetrachloride), Knight & Thomas (Inc.), Boston, Mass.

Protector No. 10 (40 gallons capacity. This fire extinguisher shall be given the following rating: On any steam vessel required to carry less than 10 fire extinguishers this fire extinguisher shall be allowed a rating of 1 ordinary 2½-gallon fire extinguisher. On any steam vessel required to carry 10 and not more than 14 fire extinguishers not more than 1 Protector No. 10 fire extinguisher shall be allowed a rating of three 2½-gallon fire extinguishers. On any steam vessel required to carry 15 and not more than 18 fire extinguishers not more than 1 Protector No. 10 fire extinguisher shall be allowed a rating of five 2½-gallon fire extinguishers. On any steam vessel required to carry 19 or more fire extinguishers not more than 2 Protector No. 10 fire extinguishers shall be allowed a rating of five 2½-gallon fire extinguishers each, or a total rating of ten 2½-gallon fire extinguishers.) Knight & Thomas, Boston, Mass.

Pyrene (1 quart, carbon tetrachloride), Pyrene Manufacturing Co., New York, N. Y.

Queen, Harker Manufacturing Co., Cincinnati, Ohio.

Queen No. 2 (1 quart, carbon tetrachloride), Harker Manufacturing Co., Cincinnati. Ohio.

Railway and Marine, Knight & Thomas (Inc.), Boston, Mass.
Rescue, S. F. Hayward & Co., New York, N. Y.
Safety, Safety Fire Extinguisher Co., New York, N. Y.
Salvage, American-La France Fire Engine Co., Elmira, N. Y.
Security No. B, A. C. Rowe & Son, New York, N. Y.
Sieben chemical nozzle, Sieben Chemical Co., Kansas City, Mo.
Standard, Miller Chemical Co., Chicago, Ill.
Success, W. H. Johns-Manville Co., New York, N. Y.
Turner, American-La France Fire Engine Co., Elmira, N. Y.
Underwriters New No. A1, Knight & Thomas (Inc.), Boston, Mass.
Vulcan, Knight & Thomas (Inc.), Boston, Mass.
Woodhouse, Buffalo Chemical Fire Extinguisher Co., Buffalo, N. Y.

APPROVED CARBON TETRACHLORIDE FIRE EXTINGUISHERS REQUIRED TO BE CARRIED ON STEAMERS CARRYING PASSENGERS WHICH TRANSPORT AUTOMOBILES OR MOTOR VEHICLES THE MOTIVE POWER OF WHICH IS GENERATED BY ANY OF THE PRODUCTS OF PETROLEUM, OR OTHER INFLAMMABLE LIQUIDS, UNDER THE PROVISIONS OF RULE IV RELATING TO FIRE EXTINGUISHERS.

Badger's No. 1 (1 quart), Badger Fire Extinguisher Co., Boston, Mass.
Childs Model A (1 quart), O. J. Childs Co., Utica, N. Y.
Fire Gun No. 1 (1 quart), Fire Gun Manufacturing Co. (Inc.), New York, N. Y.
Kar-bo-lene (2 quarts), A. C. Rowe & Son, New York, N. Y.
La France No. 3 (1 quart), American-La France Fire Engine Co. (Inc), Elmira, N. Y.
One quart (1 quart), American-La France Fire Engine Co. (Inc.), Elmira, N. Y.
Presto (1 quart), Knight & Thomas (Inc.), Boston, Mass.
Pyrene (1 quart), Pyrene Manufacturing Co., New York, N. Y.
Queen No. 2 (1 quart), Harker Manufacturing Co., Cincinnati, Ohio.

TANKS.

No. 1 American fire-bucket tank, 15 by 27½ inches (inside measurements), when containing 21 gallons of nonfreezing chemical liquid, and fitted with six 10-quart buckets, shall be allowed in lieu of 8 fire buckets. A. C. Rowe & Son, New York, N. Y.

No. 2 American fire-bucket tank, 18 by 28½ inches (inside measurements), when containing 31 gallons of nonfreezing chemical liquid, and fitted with six 14-quart buckets, shall be allowed in lieu of 11 buckets or 1 barrel and 1 fire bucket. A. C. Rowe & Son, New York, N. Y.

New size No. 2 American fire-bucket tank, 18 by 30½ inches (inside measurements), when containing 33 gallons of nonfreezing chemical liquid, and fitted with seven 13½-quart buckets, shall be allowed in lieu of 12 buckets or 1 barrel and 2 fire buckets. A. C. Rowe & Son, New York, N. Y.

Little Giant portable hand-pump tank, allowed in lieu of the 2½-gallon fire extinguisher when having a capacity of 5 gallons. Little Giant Manufacturing Co., New York, N. Y.

No. 1 Safety fire-bucket tank, 15 by 28 inches (inside measurements), when containing 21 gallons of nonfreezing chemical liquid, and fitted with six 10-quart buckets, shall be allowed in lieu of 8 fire buckets. The Safety Fire Extinguisher Co., New York, N. Y.

No. 2 Safety fire-bucket tank, 18 by 30 inches (inside measurements), when containing 33 gallons of nonfreezing chemical liquid, and fitted with six 14-quart buckets. shall be allowed in lieu of 12 buckets or 1 barrel and 2 fire buckets. The Safety Fire Extinguisher Co., New York, N. Y.

No. 3 Safety fire-bucket tank, 18 by 35 inches (inside measurements), when containing 38 gallons of nonfreezing chemical liquid, and fitted with six 14-quart buckets, shall be allowed in lieu of 14 buckets or 1 barrel and 4 fire buckets. The Safety Fire Extinguisher Co., New York, N. Y.

BUCKETS.

Foamite fire pail, 3 gallons capacity, charged with foamite, rated as a regular fire bucket. Foamite Firefoam Co., New York, N. Y.

McLaughlin chemical fire pail. hermetically sealed, 3 gallons capacity, rated as a regular fire bucket. Daniel B. McLaughlin, Philadelphia, Pa.

APPARATUS FOR EXTINGUISHMENT OF FIRE IN COMPARTMENTS OF STEAMERS.

Clayton fire-extinguishing system. Clayton Fire Extinguishing Co., New York, N. Y.

Grimm fire-extinguishing system. The Sulphur Dioxide Co., New York, N. Y.

Harker fire-extinguishing system. The Harker Fire Extinguisher & Fumigator Co. (Ltd.), Sydney, New South Wales.

Rich marine fire-indicating and fire-extinguishing system, presented by Walter Kidde & Co., New York, N. Y.

STEAM PUMPS.

Coll's single-suction steam siphon, presented by Mr. Coll, Pittsburgh, Pa. (1872.)

Coll's improved steam siphon pump. (1874.)

Hall's duplex steam pump. (1889.)

Landsell's double-suction steam siphon, presented by H. S. Landsell, New York. (1872.)

A. Sluthouer, New Philadelphia, Ohio, fire and bilge pump. (1872.)

Sheriff's steam siphon pump. (1875.)

Van Duzen & Tift's steam jet pump, for use as a steam fire pump on steamers of 100 tons and under. (1884.)

SAFETY VALVES.

Common lever valve. (1884.)

H. G. Ashton, East Cambridge, Mass. (1872.)

Ashcroft's safety valve. (1877.)

American Steam Gauge Co., Boston, Mass.; American Spring safety valve. (1885.)

Adams spring safety valve, manufactured by Thomas Adams & Co., Manchester, England; presented by Luther D. Lovekin, Camden, N. J. (1903.)

Case & Bailey, Detroit, Mich. (1872.)

Cockburn's safety valve. (1877.)

Crosby's safety valve. (1877.)

George E. Collyer, safety valve. (1883.)

Consolidated Safety Valve Co., New York, N. Y.; pop safety valves, Richardson & Co., Troy, N. Y. (1872.)

Crosby & Meady, pop safety valve. (1888.)

J. M. Coale's pop safety valve and muffler. (1894.)

Crane pop safety valve, presented by the Crane Co. (1895; improvement, 1915.)

Crosby high-efficiency pop safety valve, presented by Crosby Steam Gage & Valve Co., Boston, Mass. (1917.)

Coale side outlet safety valve, presented by Coale Muffler & Safety Valve Co., Baltimore, Md. (1917.)

Dry Dock Engine Works, Detroit, Mich. (1873.)

Spring-loaded safety valve, presented by James W. Elwell & Co., New York, N. Y., manufactured by Lethuillier & Pinel, Rouen, France. (1904.)

Hodgin's safety valve. (1877.)

Herreshoff Manufacturing Co., pop safety valve. (1883.)

Hall's incased safety valve, when lever is permanently attached to valve casing. (1889.)

Norman L. Hayden, Columbus, Ohio, Tippet spring safety valve. (1903.)

The N. L. Hayden Manufacturing Co., Columbus, Ohio, Hercules spring-loaded safety valve. (1904.)

Kunkle Valve Co., Fort Wayne, Ind., spring-loaded safety valve. (1886.)

I. T. Kearns, pop safety valve. (1893.)

J. D. Lynde, Philadelphia, Pa. (1872.)

F. Lunkenheimer, safety valve. (1888.)

The Lunkenheimer improved pop safety valve. (1896.)

Lynde safety valve, J. E. Lonergan Co., Philadelphia, Pa. (1910.)

Morse's safety valve. (1877.)

A. Orme's safety valve. (1877.)

W. E. Pierson, pop valve. (1883.)

R. F. Silliman's safety valve. (1884.)

Scott Valve Manufacturing Co., Detroit, Mich. Formerly the Roe Stephens Manufacturing Co., Detroit, Mich., spring safety valve. (1892, 1919.)

Star Brass Manufacturing Co., pop safety valve. (1898.)

H. G. Trout, King Iron Works, Buffalo, N. Y., spring-loaded safety valve, and allowed a rating of 2 square feet of grate surface of boiler to 1 square-inch area of valve to June 1, 1904. (1885.)

Talbot combined main stop and safety valve, Talbot Boiler Co., Seattle, Wash. (1915.)

Utica pop safety valve presented by the Utica Steam Gauge Co., of Frankfort, N. Y. (1900.)

MESSAGE CASES.

Nautilus message case, presented by Capt. Wm. J. Crosby, Detroit, Mich. (1914.)

Reliance message case, presented by Joseph E. Meno, Port Huron, Mich. (1914.)

WATER LIGHTS.

Coston Res-Q-Lite for ring buoys, presented by the Coston Supply Co., New York, N. Y. (1916–1920.)

Coston Standard water lights for rafts, presented by the Coston Signal Co., New York, N. Y. (1916.)

C. C. Galbraith & Son, New York, N. Y. (1918.)

G. R. Holmes, Baltimore, Md. (1920.)

Hook seam, emergency, self-lighting, life-buoy light, presented by Henry J. Pain, New York, N. Y. (Nov. 1916.)

Rescue signal water light, presented by David Kahnweiler's Sons, New York, N. Y. (1916.)

PIPE BOILERS.

[Boilers and steam generators not constructed of riveted iron or steel plates, approved under section 4429, Revised Statutes.]

F. D. Althouse, New York, N. Y. (1889.)

F. S. Allen, New York, N. Y. (1884.)

Almy Water Tube Boiler Co., Providence, R. I. (Types A, B, and C, 1890; types D and E, 1897; Z type, 1911.)

George W. Arrowsmith, Fort Niagara, N. Y. (1894.)

American Fire Engine Co., Cincinnati, Ohio. (1900.)

Acme boiler, Detroit Water Tube Boiler Co., Detroit, Mich. (1902.)

J. L. Anderson, Seattle, Wash. (1904.)

Aultman & Taylor Machinery Co., Mansfield, Ohio. Park water-tube boiler. (1905.)

A. Perry Blivin, Brooklyn, N. Y. (1885.)

George B. Brayton, Providence, R. I. (1885.)

The Belleville boiler, presented by Miers Coryell, of New York. (1887.)

Brigham & Markham, Hartford, Conn. (1889.)

Braggin's, Rochester Machine Tool Works, Rochester, N. Y. (1889.)

Bowdish, Skaneateles. N. Y. (1890.)

John E. F. Bartlett, Brooklyn, N. Y. (1891.)

Alfred Box & Co., Philadelphia, Pa. (1892.)

Ira Bradley, Malden, Mass. (1892.)

Augustus Bailey, Spuyten Duyvil, N. Y. (1893.)

George D. Bowler, Trenton, N. J. (1893.)

Babcock & Wilcox, New York, N. Y. (1894; improved type, 1911; drum type, 1911; drum type, 1912; express type, 1914.)

L. Boyer's Sons, New York, N. Y. (1894, 1901.)

Buschmann & Layman, Baltimore, Md. (1895, 1897.)

John Bonner, Tiburon, Calif. (1895.)

C. R. Benton, Vergennes, Vt. (1896.)

Buckley patent water-tube pipe boiler, Rochester Machine Tool Works, Rochester, N. Y. (1896.)

Barr, Reynolds & Co., Rochester, N. Y.; E. P. Clapp boiler No. 1. (1897.)
George Bolland, Pittsburgh, Pa. (1897.)
Bretherton boiler, James C. Wignall, Philadelphia, Pa. (1897.)
A. J. Beach, Moline, Ill. (1898.)
Joseph G. Brassard, Central Falls, R. I. (1898.)
Edward Bounds, Pittsburgh, Pa. (1898.)
James H. Brown, Boston, Mass. (1898.)
Barr & Creelman, Rochester, N. Y. (1900.)
W. J. Boland, Chicago, Ill. (1900.)
Bugbee & Laycock, Chicago, Ill. Authentic water-tube boiler. (1901.)
Barton Boiler Co., Chicago, Ill.; Barton's flash boiler. (1904.)
Fred A. Ballin, Portland, Oreg. (1906; types Nos. 2 and 3, 1909; improved boiler, 1914.)
New design of Ballin water-tube boiler. Ballin Water Tube Boiler Co., Portland, Oreg. (1917.)
The Babcock & Wilcox Co., New York, N. Y.; White-Forster steam generator. (1909.)
B. F. Binnix, Washington, D. C. (1906.)
E. W. Bailey, Portsmouth, Va. (1907.)
Barnes pipe boiler, presented by Pierre Barnes, Seattle, Wash. (1909.)
John P. Badenhausen, Seattle, Wash. (1911; improvements, 1918.)
Bath Iron Works (Ltd.), Bath, Me. Normand boiler. (1914.)
Badenhausen Co., Philadelphia, Pa., improvements in Badenhausen boiler. (1918.)
James Beggs & Co., New York, N. Y., modification of Worthington boiler. (1918.)
C. H. Caswell, Newport, R. I. (1887.)
Miers Coryell, New York, the Belleville boiler. (1887.)
Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel; Northrop Manufacturing Co. (1888.)
H. B. Cumming, Malden, Mass. (1889.)
C. B. Crowley & E. B. Browne, Brooklyn, N. Y. (1889.)
Clapp & Jones Manufacturing Co., Hudson, N. Y. (1889.)
Crawford & Saunier, Newark, N. J. (Passaic, 1890; Gem, 1891.)
Cruickshank, Providence, R. I. (1890.)
E. J. Copeland, New York, N. Y. (1891.)
Cary's steam generator, changed from Gray's, Providence, R. I. (1891.)
Edward S. Clark, Boston, Mass. (1891, 1895, 1898.)
Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891, 1902.)
Clay & Torbensen, Camden, N. J. (1892.)
Cole & Reinhart, Camden, N. J. (1892.)
Louis S. Clark, Pittsburgh, Pa. (1893.)
A. E. Corey, Allegheny, Pa. (1893.)
Coller Yacht & Engine Works, Detroit, Mich.; Coller sectional boiler. (1893, 1895.)
E. P. Clark, New York, N. Y. (1894.)
The Coulter & McKenzie Machine Co., Bridgeport, Conn. (1894.)
Christiansen marine boiler; John A. Duggan, Boston, Mass. (1894.)

C. R. Cowley, Brooklyn, N. Y. (1895.)
Baylies C. Clark, New York, N. Y. (1896.)
J. F. Craig, Toledo, Ohio; Craig water-tube boilers, Nos. 1 and 2. (1896.)
E. P. Clapp boiler No. 1; Barr, Reynolds & Co., Rochester, N. Y. (1897.)
William Cramp & Sons, Philadelphia, Pa.; Yarrow type No. 2, and Niclausse water-tube boiler. (1897.)
W. T. Clark, Boston, Mass. (1897.)
Osceola Currier, Newark, N. J. (1897.)
E. P. Chancellor, Parkersburg, W. Va. (1898.)
J. Castleman, Brooklyn, N. Y.; T. F. Morrin's pipe boiler. (1898.)
James Carnegie, New York, N. Y.; type B. (1899.)
Peter Cone, Jacksonville, Fla. (1899.)
Ed. Cheetham, Detroit, Mich. (1900.)
Chas. R. Cowley and Howell C. Cooper, Everett, Mass.; Cowley & Cooper boiler. (1901.)
Charles D. Casad, Seattle, Wash. (1902.)
C. B. Clark, South Brewer, Me. (1902.)
B. F. Cook, Fort Pierce, Fla. (1902.)
E. J. Codd, Baltimore, Md.; Smith patent boiler. (1904.)
Will F. Cook, Oshkosh, Wis. (1906.)
Fred Cline, Hoquiam, Wash. (1911.)
Craig Shipbuilding Co., Long Beach, Calif. (1915.)
J. M. Colman, Everett, Wash. (1916.)
D. Connelly Boiler Co., Cleveland, Ohio; Connelly standard water-tube boiler of the drum and bent-tube type, and the Connelly water-tube boiler of the header and straight-tube type. (1917.)
The Casey-Hedges Co., Chattanooga, Tenn. (C-H water-tube boiler, 1917; vertical baffle type C-H water-tube boiler, 1918.)
Colven water-tube boiler, New York Engineering Co., New York, N. Y. (1918.)
Carnegie Steel Co., Pittsburgh, Pa. (1920.)
E. G. Durant, for using petroleum. (1888.)
L. D. Davis, Erie, Pa. (1891, 1894, 1898.)
Anson C. Dearing, Detroit, Mich. (1894.)
Charles De Vore, Philadelphia, Pa. (1894.)
J. J. Driscoll, Stapleton, N. Y. (1894.)
George E. Dow, Seattle, Wash. (1894.)
John A. Duggan, Boston, Mass.; Christiansen marine boiler. (1894.)
J. W. Dawson, Wyandotte, Mich. (1895.)
E. N. Drouillard, Wyandotte, Mich.; Drouillard water-tube boiler No. 1. (1896.)
Robert Don, Stockton, Calif. (1897.)
Dearing water-tube boiler, Detroit, Mich. (1897.)
Detroit Screw Works, Detroit, Mich.; Taylor boiler. (1898).
A. D. Davis, Yonkers, N. Y. (1899.)
Detroit Water-Tube Boiler Co., Detroit, Mich. (1899.) The Acme boiler. (1902, 1914.)
W. E. Dickey, New York, N. Y.; porcupine boiler. (1902.)
C. F. Davenport, Brooklyn, N. Y.; assigned to Empire State Engineering Co., New York, N. Y. (1904.)

William F. Duval, Jersey City, N. J. (1904.)
Dobler boiler attachment or water heater; presented by W. R. Miller, New York, N. Y. (1906.)
P. F. Dundon, San Francisco, Calif. (1916.)
F. W. Edwards, Bayonne, N. J. (1899.)
Benjamin P. Emery, Kennebunkport, Me. (1899.)
Henry Ernst, New York, N. Y. (1901.)
A. C. Evans, Norfolk, Va. (1901.)
Emergency Fleet Corporation's standard water-tube boiler, Emergency Fleet Corporation, Washington, D. C. (1917; modification, 1917.)
Farnie & Geer, Syracuse, N. Y.; the Farnie boiler, steam pressure to be allowed on such boiler as the bracing will entitle the same to carry. (1887.)
Hugo L. Frederick, copper boiler. (1889.)
William Flaggs, Brooklyn, N. Y. (1891.)
Charles W. Foster, New Haven, Conn. (1892, 1894, 1895.)
W. S. Fairchild, Newark, N. J. (1892.)
Walter B. Fowler, Lawrence, Mass. (1892.)
H. H. Frederick, New Orleans, La., 3 horsepower. (1893.)
Thomas Fearon, Yonkers, N. Y. (1893, 1895, 1897.)
Fenlayson & Popkins, Detroit, Mich. (1893.)
John A. Flajole, Bay City, Mich. (1894.)
William Flagg, Bayonne, N. J. (1895, 1898.)
H. E. Frauz, steam generator; presented by J. H. Mittendorff, Washington, D. C. (1895.)
A. W. Finlayson, Detroit, Mich. (1896.)
Fore River Engine Co., Weymouth, Mass. (1897.)
Fowler-Wolfe Sheet Metal Works, Paducah, Ky.; improvement in Kidney boiler. (1915.)
Foster marine boiler, Power Specialty Co., New York, N. Y. (1917.)
Horace Furman, Petersburg, Va. (1918.) Two steam drums replaced with one, and other modifications. (1919.)
Samuel M. Gray, Providence, R. I. (1890, 1896.)
Goodridge attachment for oil boilers. (1891.)
Gem boiler, Crawford & Saunier, Newark, N. J. (1891.)
J. M. Glover, Baldwin, Long Island, N. Y. (1892.)
James S. Gedeohn, Cleveland, Ohio; pipe boiler. (1892.)
Griswold pipe generator, Henry Suttor. (1893.)
E. U. Gibbs, Elmira, N. Y. (1894.)
C. F. Gallion, Baltimore, Md. (1895.)
T. W. Godwin & Co., Norfolk, Va. (1896.)
Gas Engine & Power Co. and Charles L. Seabury & Co., New York, N. Y. (Types E, Alga, and Enterprise, 1898; Kanawha type, 1899; D improved and E improved, 1903.) See S—Charles L. Seabury & Co.
Siren Galliher, Normal, Ky. (1898.)
F. G. Gibson, Dorchester, Mass. (1899.)
Thomas Gowen, Seattle, Wash. (1908.)
R. J. Galbraith, Albany, Oreg. (1911.)
R. J. Galbraith, Coquille, Oreg. (1916; one with cast steel heads, 1917.)

Herreshoff, Bristol, R. I. (1873, 1878, 1898.)
Type of Herreshoff boiler, presented by Herreshoff Manufacturing Co., Bristol, R. I. (1919.)
S. P. Hedges, Greenport, N. Y. (1885, 1889, 1895.)
Hazelton Co., water-tube porcupine boiler. (1886.)
V. R. Hyde, Portland, Oreg.; the H. Statesmen boiler. (1886.)
The Hartley boiler; presented by the Pioneer Iron Works, Brooklyn, N. Y. (1887.)
Hohenstein, Newark, N. J. (1890.)
T. Hansen, Boston, Mass. (1891.)
E. Hayes, Rochester, N. Y. (1891.)
F. W. Hyslop, New York, N. Y. (1892.)
Gardener C. Hawkins, Boston, Mass. (1892.)
H. J. Hancock, New York, N. Y.; Howard steam generator. (1893.)
A. C. Harding, Chicago, Ill. (1893.)
Henry Haenel, St. Augustine, Fla. (1894.)
George H. Holmes, Gardiner, Me. (1894.)
Hampden Hyde, Rochester, N. Y. (1894.)
Heine safety boiler, by E. D. Meier, St. Louis, Mo. (1895. Superheater presented by Heine Safety Boiler Co., St. Louis, Mo., 1916.)
George Harden, Detroit, Mich. (1895.)
William H. Herbertson, Cadwallader, Pa. (1896.)
Henry A. House, Bridgeport, Conn. (1897.)
Henry E. Hull, Clinton, Conn. (1899.)
George L. Haman, Detroit, Mich. (1901.)
Gordon H. Hardie, Victoria, British Columbia. (1902.)
C. W. Hawkes, Chicago, Ill. (1906.)
Frank A. Hensley, San Antonio, Tex.; porcupine boiler. (1906.)
Hohenstein marine boiler; presented by Oil City Boiler Works, New York, N. Y. (1907.)
A. M. Hunt, Tacoma, Wash. (1914.)
Howden & Co., Glasgow, Scotland. (1915.)
A. C. J. Hennig, Seattle, Wash. (1916.)
Hermens Steam Motor Co. (Inc.), Portland, Oreg. (1920.)
International Power Co., Providence, R. I. (1900.)
Ernest A. John's boiler, New York, N. Y. (1892.)
J. B. Jardine, San Francisco, Calif. (1894.)
J. R. Jackson, McKeesport, Pa. (1894.)
W. E. Jenkins and A. Stokey, Tacoma, Wash. (1900.)
Geo. E. Jones, Newark, N. J. (1900.)
Ernest N. Janson, Washington, D. C. (1901.)
Johnston Service Co., Milwaukee, Wis. (1907.)
Robert Joy, Oswego, N. Y. (1918.)
John R. Karstendick, New Orleans, La. (1884.)
Charles L. Kraemer, New York, N. Y. (1898.)
J. H. King, Daytona, Fla. (1899. Modification, 1900, presented by J. B. Sloan, Jacksonville, Fla.)
Chas. Kellogg, Athens, Pa. (1900.)
Geo. Krill & Bro., Baltimore, Md. (1900.)
Charles H. Kimball, Plattsburg, N. Y.; Kaelma boiler. (1902.)
C. W. Krotz, New Orleans, La. (1903.)
Keep & Co., Portland, Oreg. (1904.)

James W. Kidney, Point Pleasant, W. Va.; combination water-tube and fire-tube boiler. (1912. Improvement, 2 shells, 1913; improvement, 1915.)

Changes on construction of Kidney boiler, presented by the Marietta Manufacturing Co., Point Pleasant, W. Va. (1919.)

Lidback Manufacturing Co., Portland, Me. (1890.)

J. Lacroix and Ed Rey, New Orleans, La. (1892, 1898.)

Laughlin & Co., Pittsburgh, Pa. (1893.)

John H. Lutz, Michigan City, Ind. (1894.)

J. H. & J. D. Lucas, St. Louis, Mo. (1895.)

L. W. Loomis, Carrollton, Ill. (1896.)

William H. C. Lyons, Philadephia, Pa. (1896.)

Paul W. Lichtenberger, Philadelphia, Pa. (1897.)

Luippold Bros., Buffalo, N. Y. (1897.)

Geo. Lawley & Son Corporation, Boston, Mass. (1900.)

Harry Lawson, Jersey City, N. J. (1900.)

Joseph C. Lesley, St. Albans, Vt. (1900.)

S. C. Lighthill, Allegheny, Pa. (1900.)

W. S. Lowe, Lima, Ohio. (1900.)

L. A. Langmaid, Bath, Me. (1901.)

Harry Lawson, New York, N. Y. (1904.)

U. G. Lee, Chicago, Ill. (1904.)

Locomotive boiler; presented by the Locomobile Co. of America, Chicago, Ill. (1904.)

Lyons Co., furnace boiler, Depere, Wis.; Bonson type. (1905.)

Thomas H. Lee, Seattle, Wash. (1917.)

E. W. Millard, Troy, N. Y. (1889.)

C. B. Mosher, Amesbury, Mass. (1891.)

McQueen boiler; Sullivan & Ehler, Albany, N. Y. (1891.)

The Morrin Climax steam generator, Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891. Improved boiler, 1902.)

T. F. Morrin's pipe boiler; J. Castleman, Brooklyn, N. Y. (1898.)

T. F. Morrin, Brooklyn, N. Y.; horizontal and vertical types of water-tube boiler. (1900.)

Frank Mahoney, New York, N. Y.; a horizontal boiler and a vertical boiler. (1892.)

McBride Bros.' boiler, Philadelphia, Pa. (1892.)

C. McDonagh, Hancock, Mich. (1892.)

E. A. Magee, Brooklyn, N. Y. (1893.)

Joseph Mohr, Chicago, Ill. (1893.)

I. G. Morgan, Seattle, Wash. (1894.)

W. W. Moore, Eugene, Oreg. (1894.)

R. Munroe & Son, Pittsburgh, Pa. (1894.)

J. H. Mittendorff, Washington, D. C.; H. E. Frauz steam generator. (1895.)

W. J. McCaffrey and Charles Hilbert, Sing Sing, N. Y. (1895.)

John Mohr & Sons, Chicago, Ill. (1896.)

August Miller, Jefferson Parish, La. (1897.)

G. F. Martin, St. Joseph, Mich. (1897.)

George F. Martin, Benton Harbor, Mich. (1898.)

George H. Mallett, Westchester, N. Y. (1898.)

J. W. McQueen, Detroit, Mich. (1899.)

Edward J. Moore, Philadelphia, Pa. (1899.)

Tug *Maytham*, Houghton, Mich.; copper fire furnace, special. (1899.)
Walter MacFarlane, Seattle, Wash. (1900.)
Marine Iron Works, Chicago, Ill. (1901.)
Philip J. Miller, Annapolis, Md. (1903.)
James McCartney, Mobile, Ala. (1904.)
Charles D. Mosher, Mosher Water Tube Boiler Co., New York, N. Y., types A and B. (1904.)
The W. D. McNaull water-tube boiler, Toledo, Ohio. (1905.)
Miner flash steam generator, Winthrop Waite, New York, N. Y. (1907.)
James J. Morris, Nashville, Tenn.; flash boiler. (1910.)
W. J. Montgomery, Detroit, Mich. (1911.)
Meier boiler and superheater, Heine Safety Boiler Co., Phoenixville, Pa. (1917.) Superheater approved, and modifications. (1919.)
Northrop Manufacturing Co.; Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel. (1888).
Niclausse water-tube boiler; William Cramp & Sons, Philadelphia, Pa. (1897.)
New York Engineering Co., New York, N. Y. (1919.)
New York Safety Steam Power Co., New York, N. Y.; the Worthington boiler. (1891, 1897.)
New York Shipbuilding Co., Camden, N. J. (1902.)
Nott marine boiler, Nott Fire Engine Co., Minneapolis, Minn. (1906.)
Harvey T. Nye, Toledo, Ohio. (1908.)
Newport News Shipbuilding & Dry Dock Co., Newport News, Va.; type of Thornycroft boiler. (1910.)
Normand boiler, presented by Bath Iron Works (Ltd.). (1914.)
Noel marine tubular boiler, Fabian P. Noel, Washington, D. C. (1918.)
Ofeldt's, Newark, N. J. (1889.)
Marvin E. Otis, Rochester, N. Y. (1891.)
William Oldman, jr., Buffalo, N. Y.; horizontal and vertical boilers. (1896, 1897.)
Charles Ogle and James Hall, Jeffersonville, Ind. (1897.)
F. W. Ofeldt & Sons, Brooklyn, N. Y. (1901.)
James E. Orme and Henry H. Orme, St. Paul, Minn. (1902.)
Oil City Boiler Works, New York, N. Y.; Hohenstein marine boiler. (1907.)
August Ofeldt, New York, N. Y.; circular pipe boiler and square pipe boiler. (1909.)
Pioneer Iron Works, Brooklyn, N. Y.; the Hartley boiler. (1887.)
Passaic boiler, Crawford & Saunier, Newark, N. J. (1890.)
M. H. Plunkett, boiler, Nos. 1 and 2, Baltimore, Md. (1892.)
Perkins & Richmond, Grand Rapids, Mich. (1894.)
Frank Printz, New Orleans, La. (1895.)
Charles S. Parker, Orange, Tex. (1895.)
R. C. Price, Allegheny, Pa. (1895.)
George E. & Charles A. Painter, Pittsburgh, Pa. (1896.)
William E. Plummer, jr., Buffalo, N. Y. (1896.)
Joseph Provuncher, East Providence, R. I. (1896, 1898.)
D. A. Park, Brooklyn, N. Y. (1897.)

Dr. E. L. Parker, Detroit, Mich. (1898.)
J. E. Parker, Chicago, Ill. (1900.)
Archibald Pifer, Braidentown, Fla. (1900.)
Parker Boiler Co., Philadelphia, Pa. (1901.)
Thomas B. Perkins, Grand Rapids, Mich. (1901; improved porcupine boiler, 1903.)
S. T. Powers, New Orleans, La.; porcupine boiler. (1903.)
Pearson Manufacturing Co., Allegheny, Pa.: Pittsburgh boiler. (1904.)
Park water-tube boiler, by the Aultman & Taylor Machinery Co., Mansfield, Ohio. (1905.)
Page Boiler Co., Chicago, Ill.; Page sectional water-tube boiler. (1919.)
E. E. Roberts, New York. (1883.)
Rochester Machine Tool Works, Rochester, N. Y. (Braggin's boiler, 1889, 1894; Buckley patent water-tube pipe boiler, 1896.)
Martin R. Ruble, Newark, N. J. (1891.)
F. J. Robinson, Detroit, Mich. (1891.)
D. Rousseau, New York, N. Y. (1894.)
C. Reinhardt, Baltimore, Md. (1895.)
Roberts water-tube boiler, New York, N. Y. (1883; improvements in boiler, 1895; types F, G, H, and I, 1897.)
Roberts water-tube boiler, modification consisting of drum with bumped head. (1912.) The Roberts Safety Water Tube Boiler Co., Red Bank, N. J.
J. B. Rives, St. Paul, Minn.; Waterous boiler. (1896.)
Phil Rohan, St. Louis, Mo.; Western water-tube boiler. (1898.)
Jacob Ruf, Newark, N. J. (1899.)
T. W. Rucker, St. Louis, Mo. (1899.)
Erdix Rounds, Owensboro, Ky. (1900.)
A. L. Rhodes, West Superior, Wis. (1902.)
Racine Boat Manufacturing Co., Muskegon, Mich.; Racine water-tube boiler. (1904.)
Risdon Iron Works, San Francisco, Calif. (1904.)
Risdon Iron and Locomotive Works, San Francisco, Calif. (1910.)
Josiah Robinson, Watervliet, N. Y. (1904.)
C. M. Raymond steam boiler, the Dieter Steam Engine Co., New York, N. Y. (1905.)
Charles G. Rogers, water-tube boiler (modified form Roberts coil boiler), Pittsburgh, Pa. (1905.)
James J. Rohan, St. Louis, Mo. (1908.)
Charles A. Rush, San Francisco, Calif. (1909.)
E. Gerry Roberts, Red Bank, N. J.; Star in the Diamond boiler. (1917.)
Ruemmeli-Dawley Manufacturing Co., St. Louis, Mo. Boiler approved, and change in construction. (1919, 1920.)
Willis W. Roff and N. W. Bower, Douglas, Alaska. (1920.)
The Shipman boiler, for using petroleum. (1886.)
The H. Statesmen boiler, presented by V. R. Hyde, Portland, Oreg. (1886.)
James B. Stead, sectional water-tube boilers, Nos. 1 and 3. (1888.)
Charles L. Seabury, Nyack, N. Y. (1889, 1891, 1894, 1895, 1897.) See Gas Engine & Power Co. and Charles L. Seabury & Co.

W. J. Sanderson, Syracuse, N. Y. (1890.)
Harris K. Stroud, Hastings, Minn. (1890.)
Sullivan & Ehler, Albany, N. Y.; McQueen boiler. (1891.)
Thomas L. Sturtevant, Boston, Mass. (1891, 1892, 1895.)
Shortt Duplex Boiler Co., New York, N. Y. (1892.)
W. D. Smith, Detroit, Mich. (1892.)
Henry Sutter, Griswold pipe generator and Sutter sectional porcupine boiler. (1893.)
Stillman Saunders, Providence, R. I. (1893.)
Seachrist & Parker, Erie, Pa. (1893.)
Lewis Saunders, Lawrence, Mass. (1894.)
Lee H. Stevens, New Albany, Ind. (1894, 1895.)
B. T. Squier, New York, N. Y. (1895.)
William Skelton, jr., Buffalo, N. Y. (1895.)
Halcyon Skinner, Yonkers, N. Y. (1895.)
Horace See, New York, N. Y. (1895; improvements Nos. 1 and 2, 1904.)
Jacob H. Smith, Baltimore, Md. (1895.)
Isaac E. Shepardson, Providence, R. I. (1896.)
Richard Spreckles and Walter J. Wayte, San Francisco, Calif. (1898.)
Charles Stillwell, Hampton, Va. (1898.)
Wallace Stebbins & Sons, Baltimore, Md. (1900.)
The Schaffer Machine & Manufacturing Co., Baltimore, Md. (1902.)
George W. Swartz, Decatur, Ala.; porcupine boiler. (1902.)
Emil Santsche, Eureka, Calif.; porcupine boiler. (1903.)
Salamandrine boiler, manufactured by the Salamandrine Boiler Co., Newark, N. J.; presented by H. L. Ricks, Eureka, Calif. (1903.)
Schwing & Greaud, Gramercy, La. (1904.)
J. A. Shaw, Newark, N. J. (1904.)
Smith patent boiler, presented by E. J. Codd, Baltimore, Md. (1904.)
Stickney safety steam generator, H. R. Stickney, Portland, Me. (1905.)
Spokane Machinery Supply Co., water-tube boiler. (1905.)
Benjamin T. Squier, Brooklyn, N. Y. Towne water-tube boiler. (1906.)
Scott Engine & Construction Co., New York, N. Y. Types A and B. (1908.)
Stanley Motor Carriage Co., Newton, Mass. Shell is made of steel plate wound with steel piano wire. (1912.)
Stark & Carlyle water-tube boiler, David Stark and Arthur R. Carlyle, San Francisco, Calif. (1912.)
John M. Sweeney, Chicago, Ill. Combination fire-tube and water-tube boiler. (1912.)
Studdert Pipe Boiler Co., Seattle, Wash. Improvement in Taylor boiler approved in 1895. (1915.)
Star in the Diamond boiler, E. Gerry Roberts, Red Bank, N. J. (1917.)
John C. Sherry, Portland, Oreg. (1917.)
G. E. Tregurtha, Boston, Mass. (1890, 1892.)
Taylor Bros., Trenton, N. J. (1893.)
B. Louis Toquet, Westport, Conn. (1893, 1894.)

H. H. Taylor, Detroit, Mich. (1895; improved, 1915.)
Taylor boiler, Detroit Screw Works, Detroit, Mich. (1898.)
Taunton Automobile Co., Taunton, Mass.; porcupine boiler. (1903.)
Tabrett & Lewin, San Francisco, Calif. (1903.)
Union marine water-tube boiler, Union Iron Works, Erie, Pa. (1918.)
W. J. Tierney and William Marquez, New Orleans, La. (1895.)
Winthrop Thayer, Boston, Mass. (1897.)
Thornycroft boiler, Daring and Speedy types. Thorpe, Platt & Co., New York, N. Y. (1897.)
Thornycroft boiler, type presented by Newport News Shipbuilding & Dry Dock Co., Newport News, Va. (1910.)
Thornycroft boiler, type designed by Luther D. Lovekin, of New York Shipbuilding Co., Camden, N. J. (1912.)
W. M. Towers, Rome, Ga. (1897.)
W. C. Thompson, Philadelphia, Pa. (1897.)
John Trasher, New Orleans, La. (1902.)
William R. Thropp, Trenton, N. J. (1906.)
Towne water-tube boiler, presented by Benjamin T. Squier, Brooklyn, N. Y. (1906.)
Paul A. Talbot, Seattle, Wash. (1911; improvement, 1915.)
N. A. Uren, Juneau, Alaska (1907; modification, N. A. Uren, jr., Seattle, Wash., 1912.)
Union marine water-tube boiler, Union Marine Iron Works, Erie, Pa. (1918.)
Emil Volk, New York, N. Y. (1894.)
J. E. Vincent, Palatka, Fla.; a water-tube boiler and a porcupine boiler. (1902.)
Vashon Navigation Co., Tacoma, Wash. (1917.)
Charles Ward, Charleston, W. Va. (1883; coil boiler and Navy horizontal pipe boiler, 1894; Ward's torpedo-boat boiler, Ward's torpedo-boat boiler No. 2, Ward's straight-tube launch boiler, 1895; Ward's Royal Arch or Navy boiler, 1897.)
Charles E. Ward, Charleston, W. Va. (1912.)
The Charles Ward Engineering Works, Charleston, W. Va., Dyson water-tube boiler. (1920.) Superheater to be used in connection with Ward boiler. (1920.)
Electric welding allowed for construction of headers of Ward water-tube boilers, presented by the Charles Ward Engineering Works, Charleston, W. Va.
S. Waterhouse, Boston, Mass. (1884.)
J. W. Walters & Co., sectional water-tube boiler. (1888.)
Wadham, 1315 Third Avenue, New York, N. Y. (1890.)
Worthington water-tube boiler, New York Safety Steam Power Co., New York, N. Y. (1891, 1897.)
Improvement in Worthington water-tube boiler, presented by James Beggs & Co., New York, N. Y. (1918.)
George & James Warrington, Chicago, Ill. (1891.)
C. A. Wilkerson, Lynn, Mass. (1892.)
Wickes Bros., East Saginaw, Mich. (1893.)
Warner & Papst, San Francisco, Calif. (1893.)
George L. Wright, North Andover, Mass. (1894.)

Samuel T. Williams, Baltimore, Md. (1894; modification, 1899 and 1900.)
D. Y. Williams, South Haven, Mich. (1894.)
W. Frank West, Morris Heights, N. Y. (1895.)
George Warrington, Chicago, Ill. (1895, 1902.)
Waterous boiler, J. B. Rives, St. Paul, Minn. (1896.)
R. Weston & A. M. Lemke, Saginaw, Mich. (1896.)
George L. Whittington, Sea Isle City, N. J. (1896.)
Charles P. Willard, Chicago, Ill. (1896.)
Benjamin A. Wyatt, Boston, Mass. (1897.)
Charles M. Weber, Cincinnati, Ohio. (1897.)
Watson & Peterson, Kansas City, Mo. (1897.)
Theodore H. Wyman, Sebec, Me. (1897.)
James C. Wignall, Philadelphia, Pa.; Bretherton boiler. (1897.)
Western water-tube boiler; Phil Rohan, St. Louis, Mo. (1898.)
Egbert P. Watson, Elizabeth, N. J. (1898; modification, 1900; porcupine boiler, 1903.)
Robert White, Brooklyn, N. Y. (1899.)
Beder Wood, Moline, Ill. (1899.)
George S. Wolf, West Dover, Ohio. (1901.)
E. C. Walker Co., Louisville, Ky. (1907.)
White patent steam generator, presented by The White Garage, Cleveland, Ohio. (1907.)
Winthrop Waite, New York, N. Y., the Miner flash steam generator. (1907.)
H. T. Wood, Pittsburgh, Pa. (1908.)
White-Forster steam generator, The Babcock & Wilcox Co., New York, N. Y. (1909.)
The Wickes Boiler Co., Saginaw, Mich. Wickes marine water-tube boiler. (1917.) Changes in staying. (1919.)
Whittlesey Superheating Boiler Co., Cleveland, Ohio. Whittlesey superheating boiler. (1918.)
W. Wesley Werback, Toledo, Ohio. Monarch water-tube boiler. (1919.)
Yarrow water-tube boiler, New York, N. Y. (1892.)
Robert R. Zell & Co., Baltimore, Md. (1894.)

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